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Benchmarking the implementation of total quality management and customer satisfaction in general automotive repair shops in Iowa

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Benchmarking the implementation of total quality management and customer satisfaction in general automotive repair shops in Iowa

by

Hsiu-Te Sung

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ABSTRACT

The automotive repair industry was perceived by the American customers as an industry with high cost and low customer satisfaction. The purpose of this study was to identify the relationship between the level of total quality management (TQM) implementation and the level of customer satisfaction in the general automotive repair shops in Iowa. This information promised to enable the general automotive repair shops to increase service quality and customer satisfaction.

A Total Quality System Implementation Assessment Instrument (TQSIAI) with 35 items was developed to measure the level of TQM implementation in the general automotive repair shops. A Customer Satisfaction Assessment Instrument (CSAI) with 25 items was developed to measure the level of satisfaction regarding the customers' automotive repair experience. A census of 834 Iowa general automotive repair shop service managers was conducted. Each service manager was asked to select ten randomly chosen customers and have them respond to the CSAI. A total of 31 usable TQSIAI and 107 usable CSAI were returned and coded.

The findings of this study revealed that the total hours of service managers' quality management training had a positive relationship with the level of TQM implementation, while the years of service managers' managerial experience had a negative correlation with the level of TQM implementation in the general automotive repair shops. The number of full-time employees in the general automotive repair shops had a positive relationship with the level of customer satisfaction, while the cost of the repair service and the ages of serviced vehicles had a negative relationship with the level of customer satisfaction. In addition, there was a

positive relationship between the level of TQM implementation and the level of customer satisfaction in the general automotive repair shops.

Recommendations include: improving the sampling procedure by "on-site" interviews with the service managers and customers, and using qualitative techniques to study highly successful automotive repair shops. Initiation of TQM training programs in general automotive repair shops is encouraged.

CHAPTER I. INTRODUCTION

Background of the Study

Successful automotive manufacturing companies have realized that customer satisfaction is one of the key points in determining the level of success of an organization (Lowenstein, 1995). However, Crandall (1997) wrote that: "Auto repairs are reputed to be the No. 1 consumer complaint in the nation today. In addition, automobiles are becoming more complex and difficult to service." (p. 2A). The Harvard Business School (1990) also points that:

> Among all service industries, automotive repair is perceived by American customers as having the lowest customer satisfaction. Nevertheless, customer satisfaction in the automotive repair industry is one of the most difficult issues to measure. Moreover, many automotive repair shops lack an interest or willingness to employ new management concepts in their business. (p. 116)

The reason for low customer satisfaction in the automotive repair industry may be that the cost of automotive repair is often high and the techniques can be very complicated (Andaleeb & Basu, 1994). Consequently, the customers' insufficient knowledge about automotive repair and the poor communication between customers and the industry make a customer satisfaction survey difficult to conduct. Very little research related to this problem is recorded in the literature; however, the problem still exists between the automotive repair industry and its customers.

Total quality management (TQM) is one of the most frequently mentioned management approaches used in today's service industries. In fact, Henry Ford established the theoretical basis for TQM. In 1926, his book, *My life and work*, became one of the TQM

manuals employed by industries in Japan after World War II (Stuelpnagel, 1993). However, American automotive industries did not utilize TQM practices to improve quality until the late 1980s (Lightstone et al., 1993).

Total quality management (TQM) is a management system which involves the concept of continuous improvement to improve quality, cut costs, and increase customer satisfaction (Edosomwan & Savage-Moore, 1991). According to the Quality Management Scoping Study (QMSS), there are seven key principles of TQM (U.S. General Accounting Office, 1990b): 1) leadership; 2) customer satisfaction; 3) empowerment; 4) continuous improvement; 5) accountability; 6) communication; and 7) training. The seven principles in the QMSS were utilized as powerful guidelines to the implementation of TQM in the organization.

As to the implementation of TQM, a strong total quality implementation process equation for excellence was discussed: "MBNQA + ISO 9000 = TQC" (Bureau of Business Practice, 1992). That is "the Malcolm Baldrige National Quality Award (MBNQA) criteria and the ISO 9000 standards as the two ends to the same goal which is called total quality commitment (TQC)" (p. 117).

In 1987, the MBNQA provided a nationally accepted set of criteria for evaluating companies that implement a TQM initiative. The general criteria categories are: 1) leadership; 2) information and analysis; 3) planning; 4) human resource utilization; 5) quality assurance of products and services; 6) results from quality assurance of products and services; and 7) customer satisfaction (Siegman, 1992). In 1990, the Cadillac Motor Car Company was awarded the MBNQA. Now many automotive manufacturing companies make every effort to

improve performance in the areas identified by the MBNQA criteria in order to show evidence of their product quality.

In 1992 the three major U.S. car companies, Chrysler, Ford, and General Motors, cooperated to develop "Quality System Requirement QS-9000" (QS-9000) as the quality standard for their suppliers in order to increase their product quality (Naroola, 1997). QS-9000 closely followed the guidelines of ISO 9000. With some modification, it was designed to meet the requirements of the automotive industry.

No automotive repair shops, however, have applied for the MBNQA. The MBNQA was not designed to be applied to the automotive repair industry. The QS-9000 system developed by the three big automotive companies was designed for their suppliers. It seems that TQM implementation has not received requisite recognition in the automotive repair industry. Therefore, establishing strategies for TQM implementation to increase service quality appears to be an important consideration in the automotive repair industry.

As to customer satisfaction, it is clearly vital to a company's success (Desatnick & Detzel, 1993). Customer satisfaction is strictly tied to the customer's perception of product or produced service performance (Woodruff & Gardial, 1996). It is the degree of satisfaction experience produced within and throughout all departments, all functions, and all people in an organization (Desatnick & Detzel, 1993).

Several research efforts on customer satisfaction focused on the relationship among customers' expectations, perceived performance, disconfirmation, and satisfaction level (Oliver & DeSarbo, 1988; Tse & Wilton, 1988; Yi, 1990; Oliver, 1993). As a result, a disconfirmation model was conducted in which positive disconfirmation led to increased

customer satisfaction, while negative disconfirmation led to decreased customer satisfaction. The disconfirmation model was also utilized in research about customer satisfaction in the service industries (Teas, 1993; Taylor & Baker, 1994; Alford & Sherrell, 1996).

Concerning the relationship between customer satisfaction and service quality, Chirs (1991) perceived quality as a loop which begins and ends with the customers and the focus is total customer satisfaction. Bitner and Hubbert (1994) wrote: "how the drive for quality in products and services is apparent worldwide, and that customer satisfaction is increasingly becoming a corporate goal". Research suggests that customer satisfaction and service quality are separate constructs that share a close relationship (Cronin & Taylor, 1992; Bitner & Hubert, 1994; Taylor & baker, 1994). Customer satisfaction appeared to be the moderate variable between service quality and customer purchase intentions (Rust & Oliver, 1994; Taylor & Baker, 1994).

In the automotive repair industry, Parasuraman, Berry, and Zeithaml (1985) suggested five criteria (fairness, empathy, responsiveness, reliability, and convenience) incorporated into an instrument called SERVQUAL which is used to determine the difference between customer expectations and customer perceptions related to service quality. In another effort, Lawton (1993) employed ease of use, timeliness, certainty, cost to own/use, and variety/choice as five attributes to measure customer satisfaction in the automotive repair area. However, both research studies employed customer satisfaction surveys that included the level of quality, but did not deal with the quality performance itself in the automotive repair industry. The relationship between a company's quality practices and its customer satisfaction is unclear in the automotive repair industry.

Statement of the Problem

Total quality management has been applied to the automotive industry during the past ten years, but this application is mostly in automotive manufacturing functions. There is little reference, however, to quality practices in the automotive repair industry. American consumers have the most complaints and the least reported customer satisfaction with the automotive repair industry (Crandall, 1997). The utilization of TQM to increase customer satisfaction may be an important trend for the automotive repair industry.

The seven key principles in the QMSS have been used to measure the level of TQM implementation (U.S. General Accounting Office, 1990b). What is the current status of TQM implementation regarding the seven principles in the general automotive repair shops? The level of TQM implementation in the general automotive repair shops might be different with different backgrounds of managers or with different sizes of general automotive repair shop.

The five criteria used in the SERVQUAL have been used to measure the level of customer satisfaction in the automotive repair industry. (Andaleeb & Basu, 1994). What is the current status of customer satisfaction regarding the five SERVQUAL criteria in the general automotive repair shops? The various customers might perceive different levels of customer satisfaction regarding their automotive repair experience.

Furthermore, there might be some relationship between the seven TQM implementation criteria in the OMSS and the five customer satisfaction criteria in the SEVRQUAL. The relationship between the level of TQM implementation and the level of customer satisfaction in the general automotive repair shops is still unknown.

Purpose of the Study

The purpose of this study was to identify the relationship between the level of TQM implementation and the level of customer satisfaction in the general automotive shops in Iowa. This information might enable the general automotive repair shops to increase service quality and customer satisfaction. The TQM implementation strategies in the general automotive repair shops were formulated and reported based on the results of this investigation .

Research Questions

This research attempted to answer the following questions:

1. What is the difference in the level of TQM implementation, using the seven QMSS criteria as a guide, regarding the different backgrounds of the general automotive repair shop service managers in Iowa?
2. What is the difference in the level of customer satisfaction, using the five SERVQUAL criteria as a guide, toward the automotive repair service as perceived by customers with different backgrounds?
3. Is there a relationship between TQM implementation and customer satisfaction in general automotive repair shops in Iowa?

Hypotheses

The following null hypotheses were formulated to address the research questions:

1. There is no significant difference in the level of TQM implementation among the general automotive repair shops due to service managers' ages and education levels. This hypothesis examined whether service managers' ages and education levels

affected the level of TQM implementation in the respective general automotive repair shops.

2. There is no significant difference in the level of TQM implementation among the general automotive repair shops due to the years of service managers' managerial experience. This hypothesis examined whether service managers' managerial experience affected the level of TQM implementation in the respective general automotive repair shops.
3. There is no significant difference in the level of TQM implementation among the general automotive repair shops due to the total hours of service managers' quality management training. This hypothesis examined the relationship between the total hours of service managers' quality management training and the level of TQM implementation in the respective general automotive repair shops.
4. There is no significant difference in the level of TQM implementation among the general automotive repair shops due to service managers' association membership. This hypothesis examined whether the service managers' memberships in automotive or quality associations (for example, Automotive Service Association, Society of Automotive Engineering, American Society for Quality, etc.) affected the level of TQM implementation in the respective general automotive repair shops.
5. There is no significant difference in the level of TQM implementation among different sizes of general automotive repair shops. This hypothesis examined whether the number of full-time employees affected the level of TQM implementation in the general automotive repair shops.

6. There is no significant difference in the level of customer satisfaction toward the general automotive repair shops due to customers' genders, ages, education levels, and annual family income. This hypothesis examined whether customers' genders, ages, education levels, and annual family income affected the level of customer satisfaction toward the general automotive repair shops.
7. There is no significant difference in the level of customer satisfaction due to the cost of the automotive repair service. This hypothesis examined the relationship between the level of customer satisfaction and the cost of the automotive repair service.
8. There is no significant difference in the level of customer satisfaction due to the ages of the repaired vehicles. This hypothesis examined the relationship between the level of customer satisfaction and the ages of the repaired vehicles.
9. There is no significant difference in the level of customer satisfaction among different sizes of general automotive repair shops. This hypothesis examined whether the number of full-time employees affected the level of customer satisfaction toward the general automotive repair shops.
10. There is no significant relationship between the five customer satisfaction criteria and the seven TQM implementation criteria.
11. There is no significant relationship between the level of customer satisfaction and the level of TQM implementation in the general automotive repair shops in Iowa. This hypothesis examined whether the level of overall TQM implementation affected the level of overall customer satisfaction in the general automotive repair shops.

Procedures of the Study

The following procedures were followed in conducting this study:

1. Identified the research problem.
2. Reviewed the literature.
3. Identified the population of this study.
4. Determined the subjects of the census.
5. Identified the dependent and independent variables.
6. Developed the instruments.
7. Collected data.
8. Coded research data.
9. Analyzed the data.
10. Prepared conclusions and recommendations.
11. Wrote final report.

Assumptions of the Study

The study was based on the following assumptions:

1. The managers selected to respond to the questionnaires had sufficient knowledge about the quality practices in their general automotive repair shops.
2. The managers selected to respond to the questionnaires about the quality practices in their general automotive repair shops had complete and correct understandings about the contents of the instruments.
3. The managers selected to respond to the questionnaires about the quality practices in their general automotive repair shops provided honest answers to all of the questions.

4. The customers selected to respond to the questionnaires about the level of customer satisfaction regarding their automotive repair experience understood the contents of the questionnaire.
5. The customer selected to respond to the questionnaires about the level of customer satisfaction regarding their automotive repair experience honestly answered all the questions on the questionnaire.

Limitations of the Study

According to the Standard Industrial Classification Manual (U.S. Department of Commerce, 1987), there are seven types of automotive repair shops: 1) top, body, and upholstery repair shops and paint shops; 2) automotive exhaust system repair shops; 3) tire retreading and repair shops; 4) automotive glass replacement shops; 5) automotive transmission repair shops; 6) general automotive repair shops; and 7) automotive repair shops, not elsewhere classified. Table 1.1 lists the total number of Iowa establishments of the different types of automotive repair shops. The general automotive repair shops include multiple automotive repair tasks; thus, they could represent the automotive repair industry in general. Therefore, this study utilized the general automotive repair shops as the focus of this research. In addition, this research was confined to the managers and customers in the general automotive repair shops in Iowa.

Table 1.1 Number of Iowa establishments of the different types of automotive repair shops

Type	Number
1. Top and body repair and paint shops	544
2. Auto exhaust system repair shops	84
3. Tire retreading and repair shops	24
4. Automotive glass replacement shops	52
5. Automotive transmission repair shops	53
6. General automotive repair shops	834
7. Automotive repair shops, not elsewhere classified	91
Total	1706

(U. S. Department of Commerce, 1996, p. 8)

Definition of Terms

The following terms are defined for use in the study.

Customer satisfaction: The delivery of a product or service that meets or exceeds customer expectations or requirements. It also refers to measurements that decide levels of satisfaction for the product or service provided (Cortada & Woods, 1995).

General automotive repair shops: Establishments primarily engaged in general automotive repair (U.S. Department of Commerce, 1987). A general automotive repair shop might contain multiple automotive repair tasks, such as engine repair, exhaust system repair, transmission repair, tire retreating, oil change, and so on.

ISO 9000: A set of quality standards developed in 1987 by the International Organization for Standardization (ISO). The main purpose of ISO 9000 is to guide companies to keep

their quality documentation in order to secure and improve the quality of their product or services (Cortada & Woods, 1995).

Malcolm Baldrige National Quality Award (MBNQA): The MBNQA was set up by the Department of Commerce of US government in 1987. The purpose of this award is to recognize quality achievements by American companies. The basic concept of this award is (Cortada & Woods, 1995):

> There are seven sets of quality criteria that, when properly implemented, lead an organization to perform in a superior manner—reducing waste and inefficiencies, creating a healthy workplace, and successfully serving customers. (p. 218)

QS 9000: A set of quality standards developed in 1994 by Chrysler Corporation, Ford Motor Company, and General Motors Corporation. QS-9000 is mainly applied to the supplier of these three major automotive companies to assure the quality of their product and services (Naroola, 1997).

Total quality management: A set of management practices designed to continuously improve the performance of organizational processes to profitably satisfy customers. According to Cortada and Woods (1995):

> Total quality management calls for the integration of all organizational activities to achieve the goal of serving customers. It seeks to impose standards, achieve efficiencies, to define roles of individuals within processes and the organization as a whole, to reduce errors and defects by applying statistical process control, and to employ teams to more efficiently plan and execute processes. It requires leaders willing to create a culture where people define their roles in terms of being responsible teammates and in terms of the value they add in delivering quality outputs to customers. (p. 353)

CHAPTER II. REVIEW OF LITERATURE

The purpose of this chapter was to explore and summarize the related literature on TQM implementation and customer satisfaction in the automotive repair industry. This literature review provided the basis for the design and development of the research instruments and final analyses. The initial sources of this chapter came from books, journals, conference presentations, dissertation abstracts, and information from the World Wide Web.

The first section of this chapter reviews the concepts, principles, and processes of TQM. Next comes an exploration of the theory and executive procedures of benchmarking. The quality movement and customer satisfaction in the automotive repair industry are discussed in the next section. Finally, the chapter is summarized.

Total Quality Management Concepts

Total quality management (TQM) originated in the 1930s from theorists such as W. Edwards Deming and Joseph M. Juran. The concept of TQM was applied broadly in Japan after World War II. Because of the successful implementation of TQM in Japanese industries, many American companies in the 1980s started to consider adopting the theory of TQM and then gradually implementing the concepts of TQM into their businesses (Herman & Herman, 1995). Now TQM has become one of the most popular and widely used management practices in American companies. Many organizations have adopted this managerial philosophy and practice in an attempt to improve product quality, increase customer satisfaction, secure increased market share, and raise company profits.

What is TQM? Deming (1986) condensed TQM philosophy into 14 points (Appendix A) to guide the transformation of a traditional organization. According to Blankstein (1992), Deming's 14 points are "powerful, universal axioms". The 14 points are based on the assumptions that individuals want to do their best. The job of management is to enable employees continually to improve the system in which they work. Deming's philosophy emphasizes the establishment of a cooperative and mutual trusting organizational climate. Deming recognized the need to clear the obstacles between employees and employers by driving out fear, eliminating rating and ranking, and removing barriers in order to improve the quality of work (Horine, 1993).

The definition offered in the Draft Department of Defense Total Quality Management Guide is one of many definitions of TQM. However, this definition is popularly applied (Saylor, 1992):

> TQM is both a philosophy and a set of guiding principles that are the foundation of a continuously improving organization. TQM is the application of quantitative methods and human resources to improve the material services supplied to an organization, all the processes within the organization, and the degree to which the needs of the customer are met, now and in the future. (p. 6)

Many other management theorists have similar definitions of TQM. Hammons (1994) defined TQM as:

> . . . a management philosophy that pays constant attention to the customer-focused, continuous improvement, quality-oriented way of thinking about all aspects of operating an organization that is shared and practiced by all employees as they think about and work together--with the aid of an integrated system of tools and techniques, information, and training and education–to perform the key processes of the organization. (p. 335)

Therefore, one may say that TQM is a philosophy, concept and powerful management approach. It involves the management and empowerment of people in order to create satisfied customers and improve organizational performance.

Total Quality Management Principles

Total quality management is seen as a management system which guides the organization toward success in the competitive market. Effective application of TQM principles may improve organizational structure and culture, and then secure victory in the competition for organizations. Many experts cite several different key TQM principles, but each also quotes some basic elements common to all quality management endeavors. According to the Quality Management Scoping Study (U.S. General Accounting Office, 1990b), there are seven key principles of TQM:

1. A visionary committed leadership team willing to lead the improvement effort.
2. An organization-wide understanding of customer expectations and a commitment to satisfying them.
3. Empowerment of employees at all level of the organization.
4. An understanding that quality improvement is a continuous long-term approach to improving processes, products, and services.
5. Establishment of valid approaches for measuring quality.
6. Establishment of open communication channels.
7. Development of a comprehensive quality education and training program. (p. 15)

Each principle is discussed below. When possible, criteria that can form the basis for evaluation are included.

Leadership

The first TQM principle is leadership. Leadership has been proven to be a key in the continuous quality improvement process (Steeples, 1993). Many TQM theorists brought forward their viewpoints of TQM leadership, including commitment to service, constancy of purpose, breakthrough in attitude, instituting leadership, adopting a new philosophy, quality being a company-wide process, quality being a way of management, and quality being an ethic (Reynolds, 1994). According to Oakland and Porter (1994):

> Effective leadership starts with the Chief Executive's vision, capitalizing on market or service opportunities, continues through a strategy that will give the organization competitive advantage, and leads to business or service success. It goes on to embrace all the beliefs and values held, the decisions taken and the plans made by anyone anywhere in the organization, and the focusing of them into effective, value-adding action. (p. 24)

Feigenbaum (1991) also stated that quality is a company-wide process. Applying the management strategy of TQM will take leadership in the truest form to set the vision, define strategies, and supply resources in order for the decision-making processes that will cause continuous improvement.

In order to examine the efficiency of TQM leadership, Steeples (1993) brought forward the leadership categories: a) senior executive leadership; b) quality values; c) management for quality; and d) public responsibility. In addition, the Federal Quality Institute (1993) issued 11 categories for examining quality leadership:

1. Executives' commitment, personal involvement in quality-related activities
2. Vision, quality values and customer focus policy
3. Executive communication of vision, quality values and customer focus orientation

4. Quality performance management
5. Management involvement in quality-related activities
6. Communication and reinforcement of vision, quality values and customer focus orientation
7. Quality, operation performance review
8. Union involvement
9. Partnering
10. Commitment to public responsibilities
11. Community relations (p. 48)

These leadership categories examine how the managers create and sustain clear and visible quality values along with a management system to guide all activities of the company toward quality excellence. The categories also examine how the managers integrate their public responsibility with its quality values and practices of their company.

Customer satisfaction

The second TQM principle focuses on the satisfaction of customer needs. What is customer satisfaction? According to Desatnick and Detzel (1993):

> Customer satisfaction is the degree of happiness experienced by the customers. It is produced with and throughout an organization among all departments, all functions, and all people. Customers include external purchasers of goods and services from the organization, suppliers, the local community, employees, managers and supervisors. (p. 9)

In the book *Out of the crisis*, Deming (1986) also indicated that:

> It will not suffice to have customers that are merely satisfied. An unhappy customer will switch. Unfortunately, a satisfied customer may also switch. ...

> Profit in business comes from repeated customers, customers that boast about your product and service, and the bringing friends with them. (p. 141)

Edosomwan (1991) also wrote that: "customer satisfaction is the key to quality" (p. 141). We may say that customer satisfaction refers to the level of satisfaction attitude experienced by the internal and external customers in the processes, products, or services in the manufacturing or service industries. A high level of customer satisfaction reflects a high quality organization.

As mentioned previously, there are two kinds of customers in an organization: internal customers and external customers. An internal customer is an individual inside an organization receiving a product or service which is produced by the same company. An external customer is an individual outside the organization who receives products or services of that organization (Duncan, 1995). A successful organization not only satisfies its external customers but also pays attention to the expectations of its internal customers.

To satisfy customers is the major goal of many organizations. Many studies have reported that the execution of customer satisfaction strategy has had a great influence on the success of companies. For example, Volkswagon found that when the level of customer satisfaction exceeded 85%, 96 out of 100 customers returned to the same company to purchase another new car (Zairi, 1994). If customers with a "not communicated" problem about the product or service, their return of purchase will not exceed 10%. However, if the complaint is delivered or solved, customer loyalty will increase almost 20%. It is quite obvious that there is tight relationship between customer satisfaction and company success. Aggarwal (1993) provided evidence that there is a negative relationship between customer complaints and company profits. That is, the less grumble of customers, the more profits to

the company. Therefore, most companies believe that designing and delivering a quality product or service in order to meet the customers' needs is a necessity for the success of the company.

In order to achieve organization success, an all-aspect focus on the demands of customers should be made. Ways of reinforcing customer focus include promoting direct contact with customers, collecting information about customer expectations, investigating the degree of customer satisfaction, and communicating this information in the organization (Dean & Bowen, 1994). These methods can be accomplished through the use of surveys, focus groups, and quality function deployment.

A customer satisfaction survey should measure customer satisfaction with various attributes of the products or the services. The attributes should be investigated in the beginning by conducting a customer satisfaction survey. According to Zairi (1996), the customer satisfaction survey about automotive repair services should contain questions relating to the following attributes: 1) easy to obtain service; 2) response to emergency; 3) software support; 4) wait time for engineer; 5) engineer ability; 6) repair at first call; 7) total repair time; 8) engineer attitude; 9) spare parts availability; and 10) telephone assistance.

There are a lot of factors relating to customer satisfaction, such as brand awareness, image, optical price perceptions, residual values, sales mix, sector coverage, competitive activities, etc. However, customer satisfaction surveys about the product or service are the primary drivers. The customer satisfaction survey not only can be conducted to compare other competitors, but also can be used to forecast existing and future needs of customers and linked with organization quality improvement.

Empowerment

Empowerment is the action of giving responsibility and authority to employees to make decisions (Cortada & Woods, 1995). There are many definitions of TQM empowerment, but all carry the same notion. According to Brelin et al. (1994): ". . . empowerment is delegating responsibility, authority, and accountability to front-line levels in the organization, where responsive action needs to be taken to satisfy customer expectations (p. 118).

In other words, empowerment means that the manager gives employees power to accomplish tasks and authority to make decisions about the tasks and resources. Figure 2.1 shows that there are five levels of empowerment: a) traditional management; b) quality of work life; c) quality circles; d) participative management; and e) self-directed work teams.

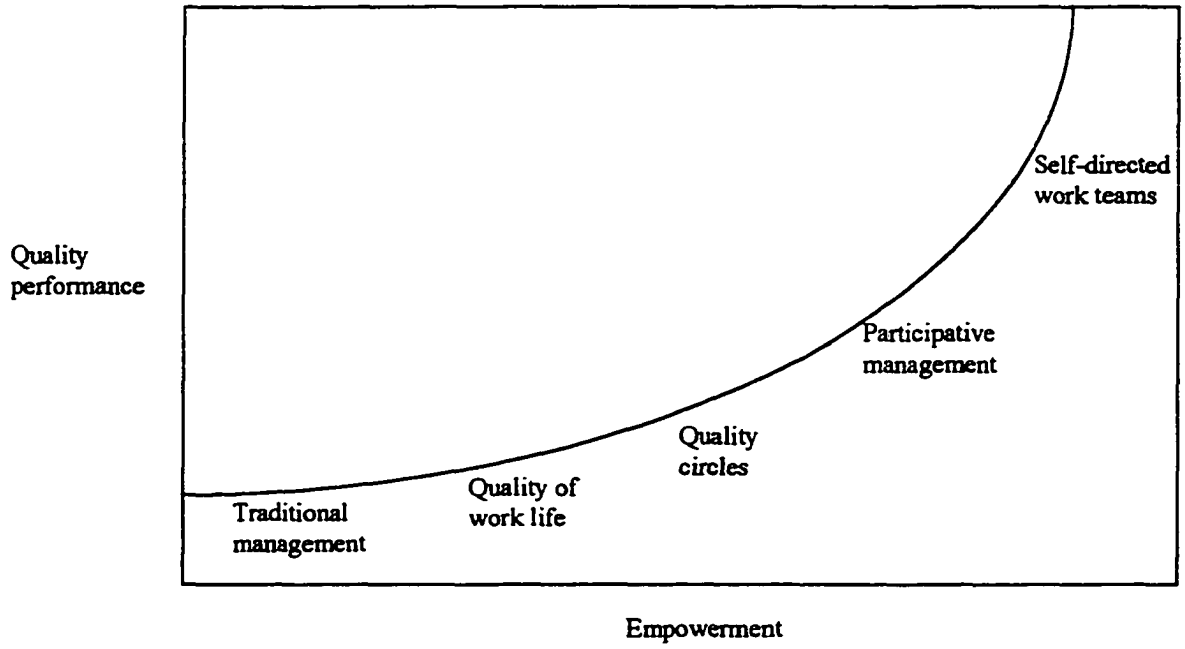


Figure 2.1 The relationship between employee empowerment and quality performance (Brown, Hitchcock, & Willard, 1994, p. 143)

When the level of empowerment gets higher, employees give a better quality performance. Specifically, empowerment provides employees with (Gitlow, Oppenhiem, & Oppenhiem, 1995):

1. the opportunity to define and document processes;
2. the opportunity to learn about processes through training and development;
3. the opportunity to innovate best practice methods that make up processes;
4. the latitude to use employees' own judgment to make decisions; and
5. an environment of trust. (p. 27)

Brocka and Brocka (1992) also noted the following practices for managers to implement empowerment. First, managers realize that employees have responsibility in the processes of a product or service, and should also be given authority to execute the policy. Second, employees should realize that they have something to contribute. The organization should provide everyone a feeling of being free to contribute. Third, it is possible that everyone may solve the problems in the organization, and managers should give the opportunity for each individual and team to explore, investigate, and solve problems.

The ultimate goal of empowerment is to open organization communication, improve and change the culture of traditional organizations. In this modern, changing, high-technology society, some forms of information technology such as an electronic bulletin board, e-mail, etc., can be applied to an organization to facilitate employee empowerment, and to make it much easier for manager and employees to consult with each other.

Continuous improvement

Another important TQM principle is continuous improvement. According to Shiba, Graham, and Walden (1993):

> Continuous improvement involves using a scientific approach to make improvement, doing step-by-step improvements to get to market fast and acquire real experience, and doing interactive improvement to reach ever-higher levels of quality. (p. 28)

Continuous improvement is a basic tool for eliminating defects and enhancing value for products and services. It provides the information for the company to analyze and reduce transit time and inventories, and improve support service.

Juran pointed out the following three essential conditions to achieving continuous improvement (Conti, 1993):

1. It must be planned;
2. It must be achieved by project; and
3. The breakthrough phase must be followed by the "holding-the-gains" phase.

A standard for considering the process of continuous improvement is the Plan-Do-Check-Act (PDCA) cycle (Pike & Barnes, 1994). The PDCA cycle emphasizes that all managers and employees should be involved in planning improvements in a process, completing the improvements, checking how well the improvements are working, and setting up standards and actions for the process.

A continuous improvement model based on the PDCA cycle is called Hoshin Management or policy deployment. Hoshin Management has three alignment purposes (Shiba, Graham, & Walden, 1993). They aim to:

1. align all the people throughout the company toward the main company goals, using indirect rather than direct enforcement.
2. align all jobs and tasks toward the main company goals in order to create breakthroughs.
3. quickly and effectively bring the company's goals and activities in alignment with rapid societal or environmental changes.

As shown in Figure 2.2, the company's long-term vision and mid-term plan should be adjusted as environmental changes occur. The mid-term plan covers one year. Moreover, the PDCA cycle is the means of accomplishing the desired outcome and measuring the accomplishment. Table 2.1 shows the five elements and examples about continuous improvement in Hoshin Management (Shiba, Graham, & Walden, 1993). Hoshin Management provides a strategy to examine the effectiveness of executing continuous improvement policy in an organization. If an organization emphasizes the implementation of continuous improvement, there must be a clear long-term vision, a mid-term plan, and a means (PDCA) of achieving the goals. Besides, the degrees of customer satisfaction and employee commitment can be also viewed as one index of an organization's execution of continuous improvement.

Accountability

Accountability is not only an important aspect in TQM, but also an action of collecting quantitative data to compare results with intended requirements in quality processes (Huddleston, 1995). Accountability serves as an essential index to the diagnosis of TQM implementation. It is often impressed in a quantitative manner, but it also can be counted with

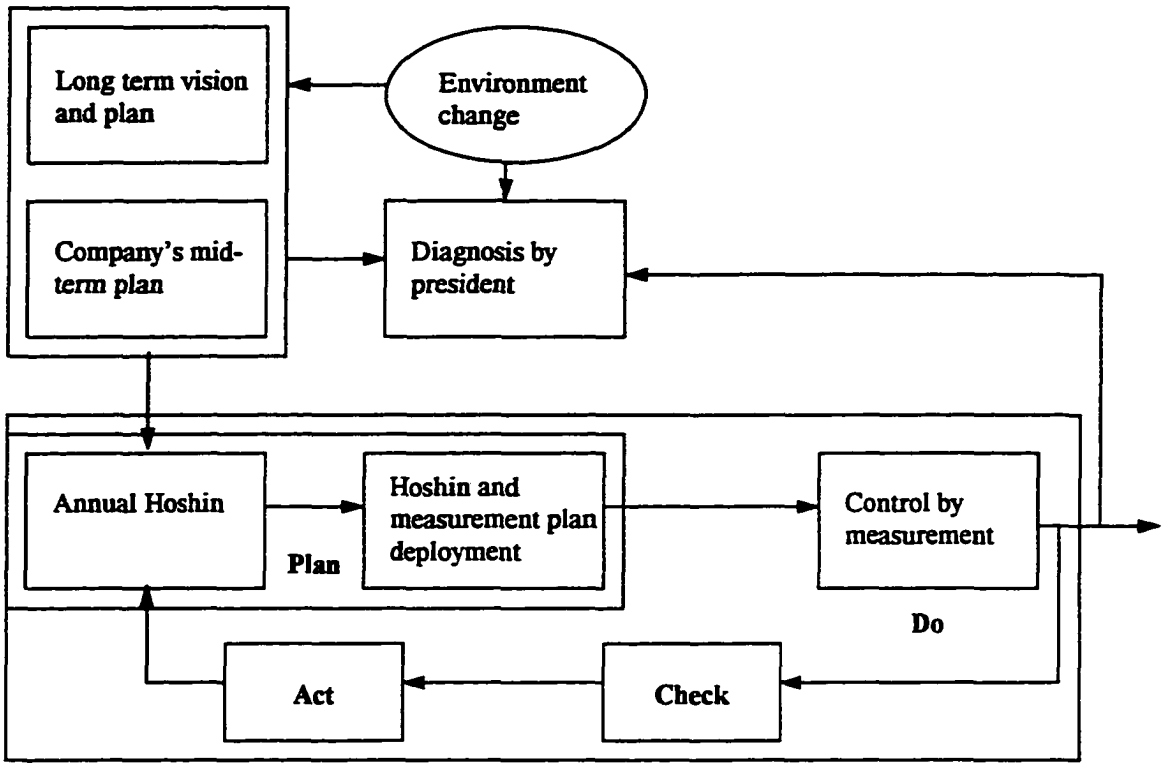


Figure 2.2 Hoshin Management (Shiba, Graham, & Walden, 1993, p. 416)

Table 2.1 The five elements of continuous improvement in Hoshin Management

	Elements	Examples
1	Statement of desired outcome for next year	• Daily practice of market-in concept
2	Focus means	• Create attractive product by improving market • Assure on time delivery improving processes
3	Metric to measure progress	• On time delivery rate
4	Target value for metric	• One hundred percent on time delivery time
5	Deadline date	• December 1997

(Shiba, Graham, & Walden, 1993, p 416)

qualitative data (Cortada & Woods, 1995). According to the U.S. General Accounting Office (1990b):

> The only way an organization can know if it is meeting quality objectives is through the use of valid measures. Measuring quality supports improvement and provides essential information on progress toward meeting objectives. Where quality measure exists, good planning follows. (p. 16)

It is clear that accountability depends on valid measurement to gain useful data. In a TQM organization, at least four outcome measures should be ongoing (Olian & Rynes, 1991): a) customer reaction measures; b) operation measures; c) financial measures; and d) employee contribution measures. The intent of this expanded use of measurement is to provide data for understanding how processes are operating in order to find an opportunity for improvement.

A TQM organization may undergo the above mentioned four measurements in their processes, but this does not guarantee that it will work to create higher product or service quality, greater customer satisfaction, lower cost, or higher employee performance. However, the planned integration of the four measurements will help the organization avoid the characteristic of having an isolated function that still contributes to all TQM objectives.

Communication

Communication is a technique for information sharing (Saylor, 1992). Traditionally, there are two ways of communicating: internal and external. Internal communication refers to the communication among managers and employees in an organization. External communication means the communication between customers and suppliers while the product or service is delivered or received (Reynolds, 1994). Internal communication can be divided into two types: vertical communication and horizontal communication. The former refers to

top-down communication while the latter means the communication among departments or employees at the same level (Weaver, 1995).

According to McLaughlin (1995a), there are four barriers existing in internal and external communication:

1. Lack of effective communication between managers and employees.
2. The communication is not objective, timely, thorough, credible, open, honest, trust-worthy, and coordinated.
3. Information is not regularly or freely exchanged or does not convey a specific message without blame.
4. Organization goals, policies, procedures, and expectations are not clearly stated.

In short, the barriers of internal communication will lead to mistrust and loss of commitment and support from employees. The result will limit improvement and creativity in the organization. Besides, external communication barriers will lead to low customer satisfaction and commitment. The result will decrease the market share of the organization.

In order to determine if the communication is successful, one may assess the communication effectiveness in an organization. McLaughlin (1995a) conducted an organization communication effectiveness survey. There are five dimensions included in the contents:

1. information exchange
2. personal/individual aspects of communication
3. organizational response and receptivity
4. message clarity

5. measure of ineffectiveness

When used to assess communication, the survey instrument provides an internal and external view of communication effectiveness and it reveals the potential problems in the communication system. With the instrument, the level and barriers to communication within an organization will be understood.

TQM can be used to guide an effective communication process within an organization. Through clear and honest communication, employees may thoroughly realize the needs of customers and the goals of the organization. This will lead to greater cooperation between managers and employees, and have positive contributions to continuous improvement and problem solving in an organization.

Training

Gravin (1993) points out that continuous improvement requires a commitment to learning. Nowadays, many human resource departments in organizations use TQM training to increase employees' skills, knowledge, and attitudes within the company. It is estimated that 92% of manufacturing and 75% of service industries provide some training programs to their employees to enhance their productivity and service (Olian & Rynes, 1991).

Saylor (1992) notes that a broad training program is an essential ingredient in maintaining a TQM environment. The contents of a training program include specific behaviors and skills required for work performance. Moreover, specific TQM training including action planning, leadership, awareness, teams, team leaders, tools and techniques, steering groups, facilities, mentors, and owners, is also required for managers and employees in the TQM organization. One criterion of the Baldrige Award emphasizes that employees

must take 40 to 80 hours' of training per year with expenditures around 3 to 5 percent of the payroll (Easton, 1993).

The total quality training process is a composite process. Figure 2.3 illustrates the ingredients of the total quality training process. The system begins with a structured training information process. Then with the support of top managers, the organization should establish a complete reward system. A thoroughly planned process for training should be managed before and after the training. The results of the training should be examined by the improvement group. Moreover, the plans and contents of the training should be filed and the trained manpower should be placed properly.

Juran (1988a) also established broad-based tasks to approach the company's training for quality:

1. Identify the company's need for training in managing for quality.
2. Prepare a curriculum of courses that can meet these needs.
3. Identify which category of personnel should take which bodies of training.
4. Identify source of needed training materials.
5. Identify the need for leaders, i.e. trainers and facilitators.
6. Establish the budget.

The skills of individuals or teams should be updated constantly to improve the processes or to reflect the improved processes. All training must consist of definite objectives and complete plans. Training must be performed at the time it is required, and it must ensure the results intended to achieve.

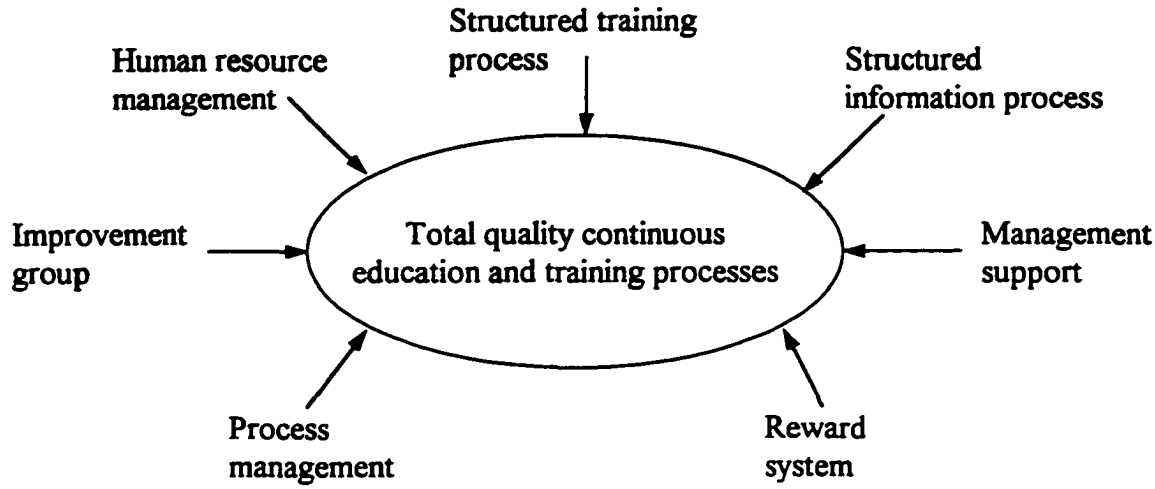


Figure 2.3 The ingredients of the total quality training process (Conti, 1993, p. 76)

Total Quality Management Processes

The workers must embrace the TQM tenets and use them as a tool in their daily work in order for the program to succeed. According to Saylor (1992), "TQM is a process itself, a process within the overall system of the organization. It transforms all the inputs in the organization into a product and/or service" (p. 231).

Figure 2.4 depicts the systems approach to TQM processes. The inputs of the system include customers' wants, desires, needs, expectations, and requirements. The inputs might relate to manpower, materials, machines, methods, and the environment. The process is the implementation of TQM while the output of the system is satisfied customers.

Oakland and Porter (1994) produced a TQM process model. In Figure 2.5, the inputs of the TQM process include materials, procedures, methods, information (including specification), people, skill, knowledge, training, and plant/equipment. The outputs include products, services, information, and paperwork.

Though considered from different aspects, the two TQM process models have similar contents. The TQM process model is based on systems theory, and from which one may clearly realize the function of TQM in a management system, and the relationship among TQM, the inputs, and outputs. Through TQM implementation, the elements of input will be employed thoroughly to reach the best quality output.

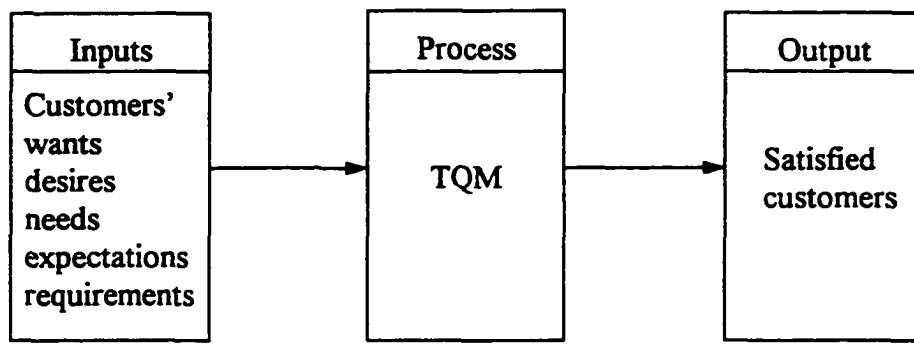


Figure 2.4 The systems approach to total quality management (Saylor, 1992, p. 10)

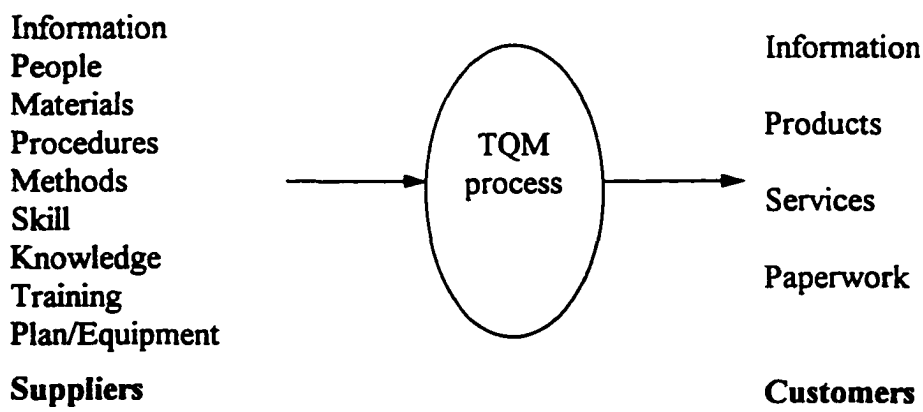


Figure 2.5 Total quality management process model (Oakland & Porter, 1994, p. 124)

In order to identify the TQM criteria for this research, a different view of TQM implementation was discussed. According to the Bureau of Business Practice (1992), the TQM process identifies two types of tasks for organizations to address (Figure 2.6). The first one is the Malcolm Baldrige National Quality Award, which focuses on seven examination elements: leadership, information and analysis, strategic quality planning, human resources utilization, quality assurance of procedure of products and services, quality result, and customer satisfaction. The second is ISO 9000, which focuses on documentation and standardization. They are discussed in more detail in later sections.

Malcolm Baldrige National Quality Award

The Baldrige Award was established in 1987 to promote quality awareness, understand the requirements for quality excellence, and share information about successful quality strategies and the benefits (National Institute of Standards and Technology, 1993).

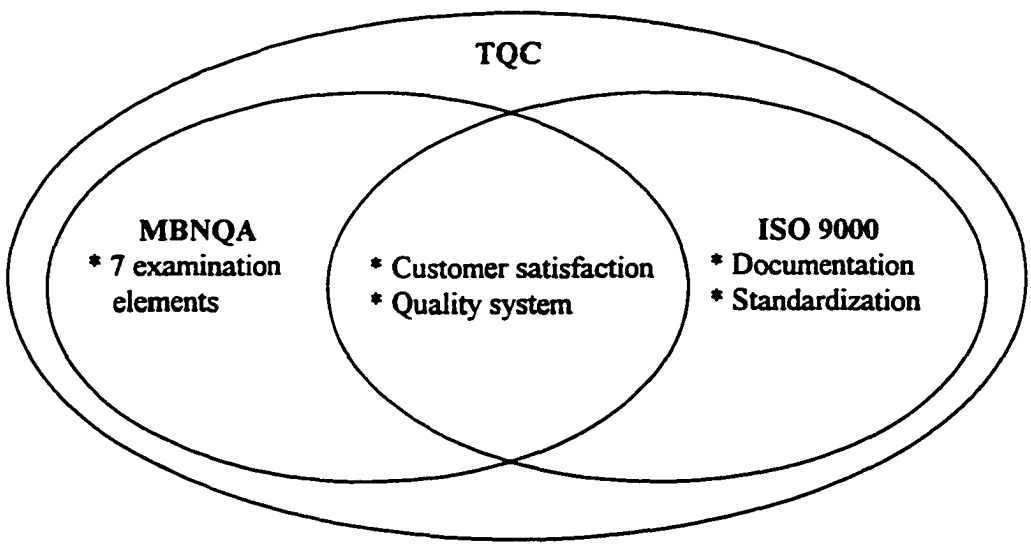


Figure 2.6 Two dimensions of total quality commitment process (Bureau of Business Practice, 1992, p. 117)

The award was based on seven examination criteria and these seven criteria were divided into 28 items of examination with 91 areas. As shown in Figure 2.7, the principle behind these seven criteria lies in the following belief: leadership drives the organization and is responsible for the construction of a quality system so as to secure organization improvement. Information and analysis, quality planning, human resource management, and process quality management are the systems which represent the management status of the company and the degree of quality. Customer focus and satisfaction, quality and operational results indicate the

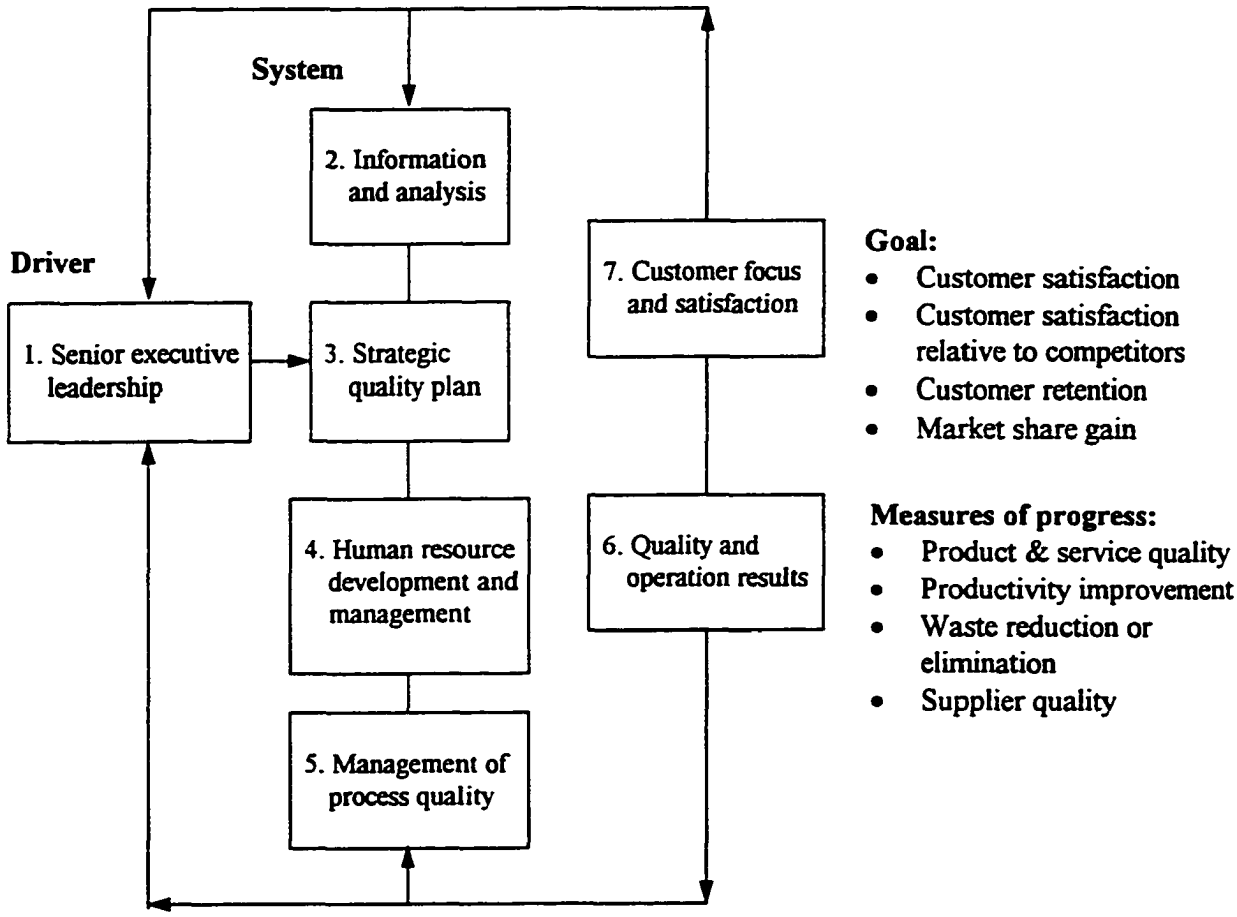


Figure 2.7 The seven criteria of Baldrige Award (Hart & Bogan, 1992, p. 16)

results of business condition. The results reflect the achievement of company goals (including customer satisfaction, customer satisfaction relative to competitors, customer retention, and market share gain) and quality improvement (including product and service quality, productivity improvement, waste reduction/elimination, and supplier quality) (Bush & Dooley, 1989).

The Baldrige Award framework shows how the criteria integrate with organization structure and process. First, the senior leadership creates the value and goal as a guide for operational performance of the organization. Then the organization system involves well-defined and complete processes to meet the performance requirement. The basic goal of the organization is to deliver increased value or performance to its customers. Measures of progress provide an indication of the improvement of organization operational performance so as to satisfy customers (Powell, 1994).

Besides the Baldrige Award, there are two other quality awards: the Deming Prize and the European Quality Award. The function of these two awards is similar to that of the Baldrige Award. All three honor the quality improvement in individuals or organizations. Table 2.2 shows a comparison among the Deming Prize, Baldrige Award, and European Quality Award. There are some differences among these three awards in overall approach, definition of quality, purpose, scope, type of organization, and key contribution, especially in the contents and portions of criteria elements.

The Baldrige Award is a positive step for quality improvement in an organization in order to regain competitive advantage. Moreover, there is a set of principles and criteria in the award that most experts agree to establish the tenets of TQM (Nakhai & Neves, 1994).

Table 2.2 The comparisons among Deming Prize, Baldrige Award, and European Quality Award

Deming Prize	Baldrige Award	European Quality Award
Overall approach:		
Management of quality	Quality of management	Quality of corporate citizenship
Categories:		
Individual, small division, large factory	Manufacturing, service, small firm	Large manufacturing
Criteria:		
1. Company policy and planning 2. Organization and its management 3. Quality control education and dissemination 4. Collection, transmission, and utilization of information on quality 5. Analysis 6. Standardization 7. Control 8. Quality assurance 9. Effects 10. Future plans	1. Leadership 2. Information and analysis 3. Strategic quality planning 4. Human resource development and management 5. Management of process quality 6. Quality and operational results 7. Customer focus and satisfaction	1. Leadership 2. Policy and strategy 3. People management 4. Resources 5. Processes 6. Customer satisfaction 7. People satisfaction 8. Impact on society 9. Business results
Definition of quality:		
Conformance to specification	Customer-driven quality	Customer, people, and community perceptions
Purpose:		
Promote quality assurance through statistical quality control techniques	Promote competitiveness through total quality management	Promote European identity through excellence in total management
Scope:		
Essentially national	National	Regional
Type of organization:		
Public, private organization	Private organization	Private organization
Examine characteristics:		
1. Visiting teams 2. Scoring methods 3. The award ceremony 4. The obligation of the winners to disseminate quality techniques	1. Visiting teams 2. Scoring methods 3. The award ceremony 4. The obligation of the winners to disseminate quality techniques	1. Visiting teams 2. Scoring methods 3. The award ceremony 4. The obligation of the winners to disseminate quality techniques
Key contributions:		
Dissemination of company-wide quality control/total quality control, continuous improvement, relations with suppliers	Customer satisfaction, competitive comparisons and benchmarking, self-appraisal model	Relations with the community, customer, and employee satisfaction, financial and non-financial results

(Nakhal & Neves, 1994, p. 36)

An element that is missing is a system for documenting and verifying a company's processes. Developed to promote better communication in a diverse European community, ISO 9000 may address the need.

ISO 9000 standards

ISO 9000 is a set of quality standards developed by the International Organization for Standardization (Mclaughlin, 1995b). ISO 9000 is also a certification which verifies that quality processes are established in a company. The purpose of ISO 9000 is to demonstrate that companies have documented their processes in 20 different categories and are executing these processes as documented (Steeples, 1993).

There are three major areas of certification in ISO 9000 (Rabbit & Bergh, 1994): ISO 9001, ISO 9002, and ISO 9003. ISO 9001 focuses on quality assurance in design/development, production, installation, and service. ISO 9002 focuses on quality assurance in production and installation. And ISO 9003 focuses on quality assurance in final inspection and testing. Table 2.3 shows the relationship between the 20 categories and the 3 series.

ISO 9000 integrates quality assurance philosophies into the manufacturing industry. These standards reinforce the concept of a functioning quality management system intent on assuring a reliable customer-focused product (Cortada & Woods, 1995). The ISO-9000 certification helps to make sure that companies execute their quality processes according to the contents of the documentation. When a company decides to apply for ISO-9000 certification, it may pursue certification for each company location or only one certification for multiple locations. The typical procedures for application are as follows (Chu, 1997):

Table 2.3 List of ISO 9000 series

Series	ISO 9001	ISO 9002	ISO 9003
Management responsibility	X	X	X
Quality system	X	X	X
Contract review	X	X	
Design control	X		
Document control	X	X	X
Purchasing	X	X	
Purchaser supplied product	X	X	
Product identification and traceability	X	X	X
Process control	X	X	
Inspection and testing	X	X	X
Inspection, measuring, and test equipment	X	X	X
Inspection and test status	X	X	X
Control of non-conforming product	X	X	X
Correction action	X	X	
Handling, storage, packaging, and delivery	X	X	X
Quality records	X	X	X
Internal quality audits	X	X	
Training	X	X	X
Servicing	X		
Statistical techniques	X	X	X

(Chu, 1997)

1. Establish a steering committee.
2. Establish implementation teams.
3. Circulate and approve the policies and procedures.
4. Document the quality system.
5. Schedule the initial visit of the registrar.

This procedure includes a period of at least six months for application, pre-assessment for three to six months, on-spot examination, and final assessment for three to six months.

The categories of ISO 9000 are written in terms of manufacturing operations. If ISO 9000 is applied to service industries, there should be different interpretations. The Bureau of Business Practice (1992) suggested that:

> For companies or a department within companies that deal with services, anytime you see the word 'production' in an ISO standard, if you substitute the word 'process', you get a little closer to what it really intended. Similarly, substitute the word 'service' for 'product' while ISO 9004-2 is specifically related toward service activities, each of the ISO 9000 series of standards can be applied to service providers. (p. 110)

It is clear that with some modification, ISO 9000 (9001, 9002, 9003) can be applied not only to manufacturing but also to service organizations. The categories provided by ISO 9004-2 are especially important references for service industries when conducting quality improvements. The categories of ISO 9004 include: a) Management responsibility, b) quality system principles, c) economic-quality-related cost considerations, d) quality in marketing, e) quality in specification and design, f) quality in procurement, g) quality in production, h) product verification, i) control of measuring and test equipment, j) nonconformity corrective action, k) handling and post-production functions, l) quality documentation and records, m) personnel, n) product safety and liability, and o) use of statistical methods.

ISO 9000 cannot replace total quality management because some issues such as leadership, strategy, planning, benchmarking, and so on are not discussed in ISO 9000 ; however, it surely provides comprehensive processes and assessing performance related to the quality process. In the automotive repair industry, many companies can not apply for ISO 9000 because of insufficient manpower and resources. However, ISO 9000 still can provide the automotive repair industry with an instrument for self-assessment of its quality improvement.

Benchmarking

Benchmarking is a tool for comparison with other organizations recognized as the best within the area. According to Anderson and Pettersen (1996):

> Benchmarking is the process of continuously measuring and comparing one's business processes against comparable processes in leading organizations to obtain information that will help the organization identify and implement improvements.(p. 4)

The American Productivity and Quality Center (1993) wrote that: "Benchmarking is the practice of being humble enough to admit that someone else is better at something and being wise enough to learn how to march and surpass them at it." (p. 6). Spendolini (1992) also defined benchmarking as: "a continuous, systematic process for evaluating the products, services, and work processes of organizations that are recognized as the representing best practices for the purpose of organization improvement." (p. 9).

Many people doubt that organizations would willingly disclose information about themselves to others. However, leading organizations have concluded that in an age of technology and information, gaining accurate insights about the market is very important to the success of all organizations. Therefore, sharing is necessary for organizations to become more successful. Table 2.4 illustrates the reasons for benchmarking. Finnigan (1996) suggested four objectives of benchmarking:

1. To find and comprehend the practices that will help them reach new standards of performance.
2. To empower their people to move forward to change existing work practices.
3. To base their goals on an external orientation.
4. To focus the entire organization on the most critical business goal.

Table 2.4 Reasons for benchmarking

Objectives	Without benchmarking	With benchmarking
	Evolutionary change	Ideas from proven practices
1. Industry best practices	• Few solutions • Frantic catch-up activity	• Many options • Superior performance
2. Defining customer requirements	• Base on history or gut feeling • Perception	• Market reality
3. Establishing effective goals and objectives	• Lacking external focus • Reactive	• Credible, arguable
4. Developing true measures of productivity	• Strengths and weaknesses not understood • Route of least resistance	• Solving real problems • Understanding outputs

(Zairi, 1996, p. 36)

Benchmarking is regarded as an important instrument for companies to understand their performance and customer requirements, which is vital to a company's success in a competitive market.

Benchmarking can be a comparison among departments within an organization or among different organizations. Organization on a whole or processes or function can be compared depending on what is being compared. There are three types of benchmarking (Anderson & Pettersen, 1996). "Performance benchmarks" are compared in order to realize how good the organization is. In "process benchmarking", the processes of production or services are compared in order to improve the processes in the organization. In "strategy

benchmarking", the planning and execution of strategy are compared in order to collect information and improve the organization's future strategic planning.

In practice, benchmarking is often used in business and industries to determine the standards for performance against four company goals: 1) customer satisfaction, 2) employee motivation, 3) market share, and 4) return on assets (Zairi & Leonard, 1994). In other words, benchmarking may determine the strengths and weaknesses of their implementation of TQM and the relationship between TQM implementation and organization performance. Moreover, organizations may discover ways of improvement from those comparisons.

According to Ross (1995), "there is no standard or commonly accepted approach to the benchmarking process" (p. 242). Different methods are employed in benchmarking depending on the different goals and objectives for a specific organization. For example, Motorola has a five-step process (Spendolini, 1992), Xerox has a ten-step model (Finnigan, 1996), and AT & T has a nine-step process of benchmarking (American Productivity and Quality Center, 1993). A four-step process—plan, do, check, and action—is a common approach to benchmarking (American Productivity and Quality Center, 1993). The "plan" step is to plan and determine what and who to benchmark. The "do" step is to collect information and data for later comparison. The "check" step is to analyze the data collected with qualitative or quantitative methods in order to identify the performance gaps among companies. The "action" step is to transfer the result gained from the analyses into the company in order to improve performance.

Zairi (1996) presents a similar explanation about the process of benchmarking. As shown in Table 2.5, the benchmarking process can be divided into four phases, and ten tasks are identified as details for completing the whole process of benchmarking.

In benchmarking, the gaps in organization performance can be identified through performance measurement. As Camp (1989) indicates:

> Benchmarking findings and operational principles based on them must be converted to action. They must be converted to specific implementation actions, and a periodic measurement and assessment of achievement must be put in place.(p. 5)

Therefore, benchmarking is consistent with performance measurement.

There are two factors to be considered in performance measurement (Zairi & Leonard, 1994): First, it must be guided by organization strategy. Second, it must be designed to

Table 2.5 The benchmarking approach

Phases	Tasks
Plan	1. Identify what is to be benchmarked
	2. Identify comparable companies
	3. Determine data collection method and collect data
Do	4. Determine current performance gap
	5. Project future performance levels
Check	6. Communicate benchmark findings and gain acceptance
	7. Establish functional goals
Action	8. Develop action plans
	9. Implement specific actions and monitor progress
	10. Recalculate benchmarks

(Zairi, 1996, p. 36)

reflect a focus on the customer, outputs/value-added activity (time, speed, cost, responsiveness), and continuous learning and innovation. Figure 2.8 displays an integrated performance measurement model in benchmarking. This model shows the major areas in benchmarking and the relationship interactions among these areas. From the comparison with each other, the gaps between organizations in TQM implementation may be uncovered.

There are many benchmarking data collection methods and sources, such as internal information, public domain information, mail survey, personal interview, telephone interview, reverse engineering, tours of other organizations, etc. The selection of data collection method depends on the researcher's time, expense, resources, and data requirements (Zairi & Leonard, 1994). No matter where the organization is, benchmarking activity is increasing, especially in Japan and the USA. It has become a necessary tool for an organization to improve or to survive.

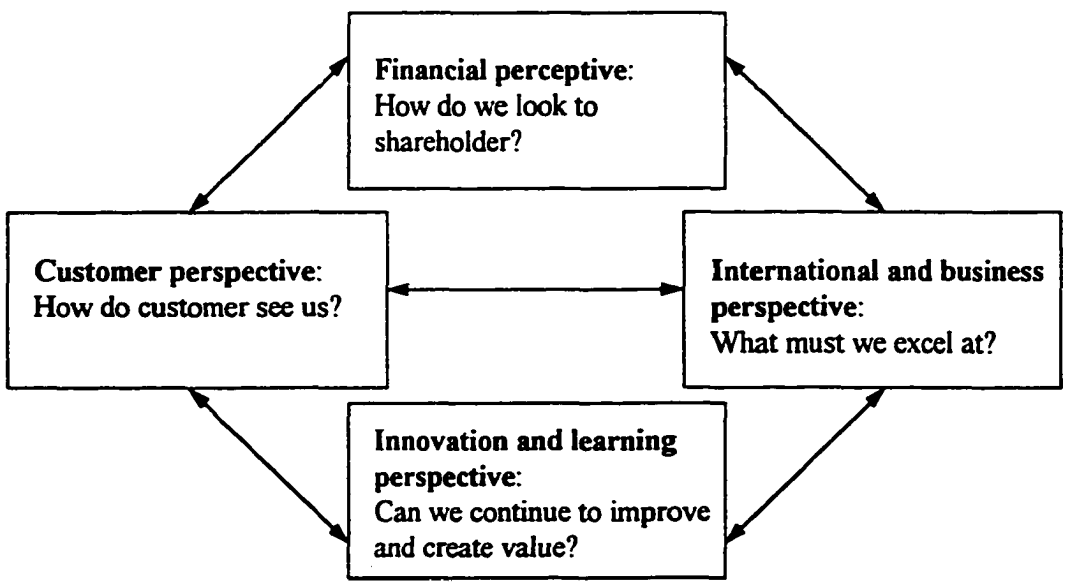


Figure 2.8 An integrated benchmarking performance measurement model (Zairi & Leonard, 1994, p. 92)

Quality Movement in Automotive Industry

"Henry Ford embraced the fundamentals of total quality management" (Stuelpnagel, 1993, p. 91). In 1926, in Ford's book, *My life and work*, the concepts of modern TQM were proposed. Such concepts include the importance of quality, customer satisfaction, continuous improvement, and so on. During World War II, the Federal War Production Board directed the automotive industry to establish the Society for Quality Control Engineers in Detroit (Lightstone, et al., 1993). This division belongs to the Automotive Division of the American Society for Quality (ASQ). The purpose of this society was to assure the quality of products to meet the needs of the military. From 1945 to 1965, the main quality focus of the automotive industry was on detection after production rather than prevention before production (Lightstone, et al., 1993).

In the 1970s, after experiencing two oil crises, the world leadership position of the American automotive industry was gradually overtaken by the Japanese. Later, with the importation of Japanese cars and the quality practices such as SPC, Quality Circles, etc., the American automotive industry was faced with its most terrible crisis ever. After 1985, the automotive industry gradually understood that quality improvement should focus on the change of organizational culture. Thus, TQM gradually became the goal or tool of most automotive companies (Lightstone, et al, 1993).

In 1990 the Cadillac Motor Car Company as the first automotive manufacturing company received the MBNQA (National Institute of Standards and Technology, 1997). By integrating quality demands into all their endeavors, from product planning to personnel practices, Cadillac successfully increased their customer satisfaction by over 14 percentage

points. It established a good model for applying TQM in the automotive industry. Nowadays many automotive service companies have already employed some aspects of TQM into their business, such as Jiffy Lube (Chu, 1996), California State Automobile Association (1997), and so on. The most important factors that influenced the automotive industry after 1990 include the ISO-9000 series, decreasing waiting time to market, response to environmental protection (Lightstone, et al, 1993), and QS-9000 (Chowdhury & Zimmer, 1996). Among these factors, QS-9000 has played the most influential role.

QS-9000 is an abbreviation for the "Quality System Requirements QS-9000". It is a common supplier quality standard which was developed by the big three U.S. companies: Chrysler Corporation, Ford Motor Company, and General Motors Corporation (Imberman, 1996). In fact, the automotive industry has a long history in establishing quality systems, and examples include Ford's Q101 Standard, General Motor's Targets for Excellence, and Chrysler's Supplier Quality Assurance Manual.

However, the difference in quality systems among different automotive companies have made it difficult for suppliers to adapt (Bureau Veritas Quality International, 1997). In 1994, the above three big automotive companies cooperated to develop QS-9000 and it greatly influenced the suppliers of these three companies. Chrysler required its suppliers to complete registration for QS-9000 by July 31, 1997, General Motors also required its suppliers to register by Dec. 31, 1997. However, the suppliers of Ford Motor are not yet scheduled for the deadline of registration (Bureau Veritas Quality International, 1997). Table 2.6 lists the compliance series of QS-9000 (Novack & Bosheers, 1997).

Table 2.6 List of compliance series of QS-9000

• Management responsibility	• Control of non-conforming product
• Quality system	• Corrective and preventive action
• Contract review	• Handling, storage, packaging, etc.
• Design control	• Control of quality records
• Document and data control	• Internal quality audits
• Purchasing	• Training
• Control of customer-supplied product	• Servicing
• Product identification and traceability	• Statistical techniques
• Process control	• Product part approval process
• Inspection and testing	• Continuous improvement
• Inspection, measuring, and test equipment	• Manufacturing capability
• Inspection and test status	• Customer-specific requirements

(Novack & Bosheers, 1997, p. 25)

The QS-9000 is based on ISO-9001, and it was developed to meet the big three automotive companies' special requirements for quality. The contents of QS-9000 include three sections (Lake, Martin, & Pett, 1995):

Section 1: Includes ISO-9000 basic requirements and repeats the standard with additional clarifications and certain specific requirements added on.

Section 2: Includes setters' specific requirements and adds three additional series: production part approval process, continuous improvement, and manufacturing capabilities.

Section 3: Focuses on the customer's specific requirements and describes those requirements which are unique to the big three automotive companies.

The assessment of QS-9000 for a company lies in a consistent, well-documented system of quality practices. To make clear the main points of QS-9000 for the suppliers, a series of checklists for every criterion were developed. Appendix B lists the questions the audit will ask of the QS-9000 applicants (ISO9000/QS-9000 Support Group, 1997). QS-9000 now is mainly applied to suppliers of production materials, production and service parts, heat treating, painting and other finishing services. It is not yet applied to automotive repair shops. Nevertheless, similar to MBNQA and ISO-9000, the checklist for QS-9000 helps to guide the development of the questionnaire for this research.

Customer Satisfaction in Service Industry

In today's service industry, customer satisfaction is emphasized because of the understanding that attracting a first-time buyer is much more expensive than keeping a current customer. According Reichheld and Sasser's (1990) study, in the service industry increasing the customer retention rate by 5% will increase the company profits from 25% to 80%. Ford Motor Company also demonstrated that dealers with higher level of customer satisfaction achieved higher return on investment (Zeithaml, Berry, & Parasuraman, 1990). Customer satisfaction has become a corporate goal in the service industry.

According to Juran (1988b), a service company is a system of special facilities and skills organized to provide service to clients. There are three characteristics of the service industries which are different from that of manufacturing companies (Dotzour & Lengnick-Hall, 1996).

1. The result of service is usually an intangible experience or performance.
2. Service is more likely to be labor-intensive.
3. Service often occurs in a relatively short span of time between production and consumption.

Since the quality of service depends much more on the interaction between customers and appraisers, it is usually subjective and difficult to measure. The researchers and managers are still confused by the relationship between service quality and customer satisfaction (Swartz, Bowen, & Brown, 1993).

Rust and Oliver (1994) described the concept of customer satisfaction in service as follows:

> Customer satisfaction is a summary cognitive and affective reaction to a service incident (or sometimes to a long-term service relationship). Satisfaction (or dissatisfaction) results from experiencing a service quality encounter and comparing that encounter with what was expected. (p. 2)

Several studies about customer satisfaction in service area have been found in the literature. Bitner (1990) reported that the interaction between employees and customers was an influential factor in customer satisfaction judgments. Dube-Rioux (1990) suggested that subjects' affective attributes were the better predictors than the subjects' cognitive evaluations on the level of customer satisfaction in the service industries. Singh (1990) used data from three different service industries to test what industry characteristics were likely to affect customers' dissatisfaction. Lately in Oliver's (1993) study, a disconfirmation model was reported. In the model there were two dimensions which influenced the level of customer satisfaction: 1) both positive and negative responses; and 2) cognitive disconfirmation. Customers are "hypothesized to bring expectations into an exchange encounter and then to

compare these expectations with perceived performance" (Alford & Sherrell, 1996). The increased satisfaction is followed by positive disconfirmation while the decreased satisfaction is followed by negative disconfirmation. A study conducted by Cronin and Taylor (1992) indicates that there appears a causal relationship between service quality and customer satisfaction in four service industries. A subsequent research effort reports that service quality and customer satisfaction are known as major factors in consumers' purchase intentions in service environment (Taylor & Baker, 1994).

Researchers seek to uncover facts in the service industry which will influence customer satisfaction. Gravin (1987) listed eight dimensions which can build a competitive advantage for a service company: 1) performance; 2) features; 3) reliability; 4) conformance; 5) durability; 6) serviceability; 7) aesthetics; and 8) perceived quality. In addition, Parasuraman , Berry, and Zeithaml (1985) suggested 10 categories of service quality which may influence customer satisfaction: 1) reliability; 2) responsiveness; 3) competence; 4) access; 5) courtesy; 6) communication; 7) credibility; 8) understanding the customer; 9) security; and 10) tangibles.

The Berry, Zeithaml, and Parasuraman's (1991) 10 categories were shortened to five attributes called SERVQUAL. The five attributes are: 1) reliability; 2) empathy; 3) responsiveness; 4) reliability; and 5) convenience. The SEVRQUAL has been utilized to evaluate service quality and to measure customer satisfaction in many service industries such as an accounting firm (Bojanic, 1990); banking, pest control, dry cleaning, and fast food (Cronin & Taylor, 1992); discount and department stores (Teas, 1993); higher education (Ford, Joseph, & Joseph, 1993); automotive repair (Andaleeb & Basu, 1994); hospitals

(Carman, Shortell, & Foster, 1996); and retail chain, automotive insurer, and life insurer (Zeithaml, Parasuraman, & Berry, 1996).

Customer Satisfaction in the Automotive Repair Industry

In the 1950s, most companies were already aware that customer satisfaction played the most important part in the success of a business in the service industry. However, customer satisfaction in the automotive repair industry has not been discussed until recently (Andaleeb & Basu, 1994). When one's car has undergone repair or maintenance work, the customer is seldom asked if he/she is satisfied with the service offered.

Andaleeb and Basu (1994) utilized SERVQUAL in the automotive repair industry. Twenty-seven items (Appendix C) were grouped under five attributes in order to determine the level of service quality through the customer satisfaction survey. The results of Andaleeb and Basu's research indicated that a high level of perceived fairness, empathy, responsiveness, reliability, and convenience will lead to greater customer satisfaction with the service performed in the auto repair industry. In addition, Brensinger (1994) reported that SERVQUAL's attributes significantly affected the quality of dealership service.

Some consulting agencies have become aware of the importance of customer satisfaction in the automotive repair industry. For example, Automated Marketing System, Inc. (1997) developed the Customer Satisfaction Index program for the automotive repair business. The Business Research Lab (1997) also developed a questionnaire to measure the satisfaction of customers in the automotive repair industry. The five SERVQUAL attributes and the contents of the questionnaire developed by the Business Research Lab will be the

major reference for the development of the customer satisfaction measurement for this research.

Summary

In this chapter the literature related to TQM implementation and customer satisfaction in the automotive service industry were reviewed. The exploration of quality practices evolved from the TQM concepts, principles, and processes to the quality movement in the automotive industry. Customer satisfaction includes not only the general concept of customer satisfaction, but also customer satisfaction in the service industry, and customer satisfaction in the automotive repair industry. Besides, the theories and practices of benchmarking were also discussed since continuous improvement may result.

Total quality management is a management system. The implementation of TQM establishes a much stronger focus on customers' needs and expectations. The execution of TQM can provide higher quality and lower cost of automotive service to satisfy the customers. The seven principles in the QMSS were developed as guidelines for TQM implementation. The level of TQM implementation in the general automotive repair shops appeared to be measurable by using the seven principles in the QMSS as a guide.

In the automotive repair industry, customer satisfaction refers to the level of happiness perceived by the customers in their automotive repair experience. Both service quality and customer satisfaction are widely recognized as the key elements for organization success. The five criteria in the SERVQUAL were developed to be guidelines for increasing the customer satisfaction in an organization. The level of customer satisfaction in the general automotive repair shops could be measured by using the five criteria in the SERVQUAL as a guide.

Research on TQM implementation and customer satisfaction have been conducted in several industries. However, the relationship between TQM implementation and customer satisfaction is still not clear. No literature has been found that addresses this relationship in the automotive repair industry. Benchmarking could be used as a vehicle to investigate the relationship between TQM implementation and customer satisfaction in the automotive repair industry.

CHAPTER III. METHODOLOGY

This chapter describes the methodology used to ascertain the relationship between TQM implementation and customer satisfaction in the general automotive repair shops in Iowa. This chapter is divided into the following major sections: research design, population and sampling, procedures of the study, instrument development, data collection procedures, and data analysis.

Research Design

This correlation research was used to identify the relationship between TQM implementation and customer satisfaction in the general automotive repair shops in Iowa. Figure 3.1 indicates the research model used to guide this study. In this model, the service managers' background and the company size were assumed to influence the level of TQM

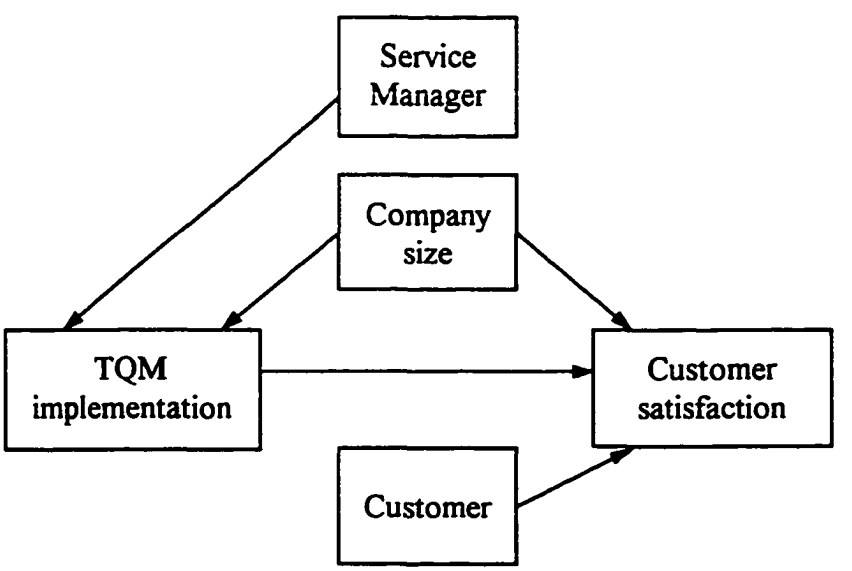


Figure 3.1 The research model of this study

implementation in the general automotive repair shops. Similarly, the customers' background and the company size might influence the level of customer satisfaction in the general automotive repair shops. Two questionnaires were utilized for the data collection. Subsequent analyses addressed the research questions.

With the data collected through these two questionnaires, the relationship between service managers' background and TQM implementation in the general automotive shops, and the relationship between the customers' background and the level of customer satisfaction regarding their automotive repair experience were identified. In addition, the relationship between the level of TQM implementation and customer satisfaction was also explored through the use of paired comparison statistical tools.

Population and Sampling

The population of this study consisted of service managers and customers of the general automotive repair shops in Iowa. There were 834 general automotive repair shops in Iowa (U.S. Department of Commerce, 1996). The entire population of 834 general automotive repair shop service managers was asked to respond to the Total Quality System Implementation Assessment Instrument (TQSIAI). Service managers were used as the population for the study since they are most familiar with the management systems in their general automotive repair shops. In addition, ten randomly chosen customers from each of the general automotive repair shop were asked to respond to the Customer Satisfaction Assessment Instrument (CSAI). There were a total of 8,340 potential respondents in this customer satisfaction survey.

Procedures of the Study

The procedures for this research followed the four steps of benchmarking: plan, do, check, and act. The research procedures were conducted as follows:

A. Plan

1. Conducted a literature review and formulated the problem.
2. Identified the population of this research, including the general automotive repair shop service managers and customers.
3. Developed two survey instruments. The TQSIAI was based on the seven Quality Management Scoping Study (QMSS) criteria while the CSAI was based on the five SERVQUAL criteria.
4. Validated the TQSIAI and CSAI using a panel of experts.
5. Revised the TOSIAI and the CSAI based on the suggestions of the panel of experts.
6. Pilot-tested the TQSIAI with service managers in the general automotive repair shops.
7. Revised the TQSIAI based on the results of the pilot-test.
8. Pilot-tested the CSAI with customers in the general automotive repair shops.
9. Revised the CSAI based on the results of the pilot-test.
10. Obtained approval from the Iowa State University Committee on the Use of Human Subjects in Research.

B. Do

11. Distributed the questionnaires to the general automotive repair shops' service managers and customers.
12. Sent follow-up letters after three weeks to increase the return rate.

C. Check

13. Coded, input, and analyzed data using the SPSS statistical package.

14. Drew conclusions, wrote a final report, and presented the report to the researcher's Program of Study committee for final approval.

D. Action

15. Suggested strategies of quality improvement for the investigated general automotive repair shops.

Instrument Development

Initial instrument development

A TQSIAI was developed to collect the data for this research. Brown, Hitchcock, and Willard (1994) suggested that, when conducting the investigation of TQM implementation in an organization, one should be armed with the factors which have the greatest impact on organizational success. Then, based on these factors, the questionnaire can be developed and distributed to the employees in the organization.

The first part of the TQSIAI explored the level of TQM implementation in the general automotive repair shops. The criteria in the TQSIAI were based on the seven TQM principles in QMSS (U.S. General Accounting Office, 1990b): 1) leadership; 2) customer satisfaction; 3) empowerment; 4) continuous improvement; 5) accountability; 6) communication; and 7) training. In addition, the MBNQA and QS-9000 were drawn upon for reference when developing the instrument so as to more closely match the reality of the automotive industry.

The second part of the TQSIAI investigated the demographic information of the service managers in the general automotive repair shops, including gender, age, education level, years of managerial experience, hours on attending quality management training ,and joining automotive or quality associations or not. The number of full-time employees of the general automotive repair shops was also determined.

A CSAI was developed as well. According to Hanan and Karp (1989), the measurement of customer satisfaction can be conducted with the customer attitude questionnaire. When developing the questionnaire, the potential factors affecting customer satisfaction should be identified.

The first part of the CSAI measured the customer satisfaction level in their automotive repair experience. The survey items were based on the five criteria of SERVQUAL (Berry, Zeithaml, & Parasuraman, 1991): 1) fairness; 2) empathy; 3) responsiveness; 4) reliability; and 5) convenience.

The second part of the CSAI investigated the demographic information of the customers in the general automotive repair shops, including gender, age, education level, annual family income, cost of repair service at this time, and the age of the vehicle. Figure 3.2 indicates the contents of each section in the TQSIAI and the CSAI and their relationship. Both instruments used a Likert-type scale with five rating levels. The service managers in the general automotive repair shops were asked to respond to the TQSIAI referring to the current level of TQM implementation in their companies. The customers who took their cars to those general automotive repair shops were asked to respond to the CSAI designed to gather their attitudes after being serviced.

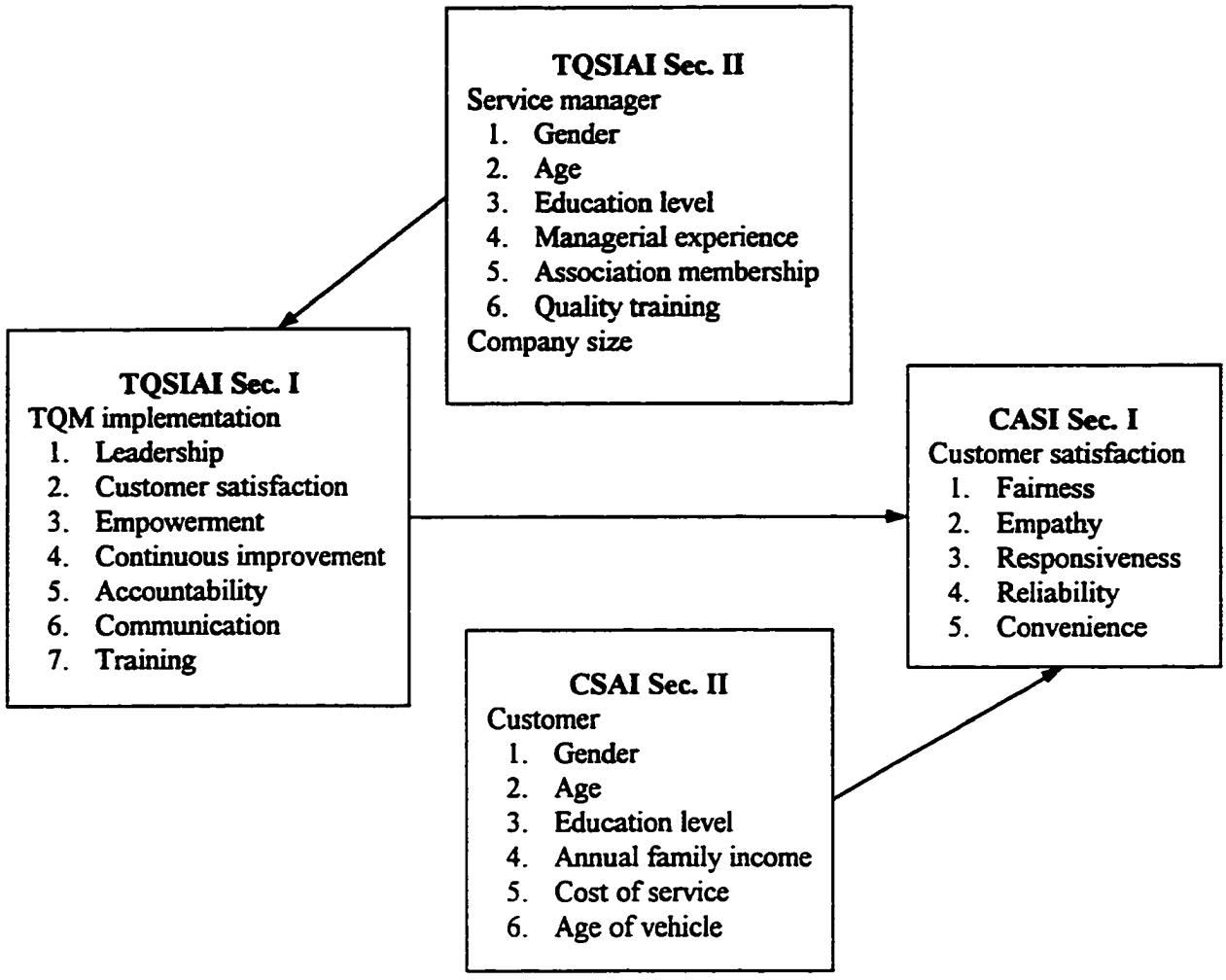


Figure 3.2 The instrument development model in this study

Validity of the instrument

The content of the TQSIAI and the CSAI were validated by a knowledgeable panel of Iowa State University professors. Fink and Koescoff (1985) suggested that a survey can be validated by identifying that its items or questions accurately represent what it is intended to be measured. According to Crocker and Algina (1986):

> The purpose of a content validation study is to assess whether the items adequately represent a performance domain or construct of specific interest...a

> typical procedure is to have a panel of independent experts judge whether the items adequately sample the domain of interest. (p. 218)

Two preliminary instruments were developed and a cover letter for the panel member was created (Appendix D, E, and F). Four professors who teach courses or conduct research related to business management or human resource development were invited to be panel members. The list of the panel members is in Appendix G.

The tasks of the panel members were to make sure that the items were appropriately classified by each criterion. In addition, the panel members evaluated the items for clarity and understanding, and suggested new items that were more appropriate. With the suggestions of the panel members, the instruments were revised.

After the data collection, a factor analysis was utilized to ascertain the construct validity of the CSAI. A separate factor analysis was also conducted to evaluate the construct validity of each criterion in the CSAI. A discussion of the construct validity of the CSAI is in Chapter Four.

Pilot testing

The pilot-test of this study was conducted with the general automotive repair shops in Ames area. The purpose of the pilot-test was to determine if the instruments were clear, understandable, and relevant. The time required to complete the questionnaires was also measured. There were 19 general automotive repair shops in Ames area. Each service manager of the 19 general automotive repair shops was asked to respond to the TQSIAI and to distribute 10 copies of the CSAI to their customers.

In the first visit, twelve general automotive repair shop service managers agreed to participate in the pilot testing of this study. After three weeks' contact, however, only six service managers and 22 of their customers completed the questionnaires. Table 3.1 illustrates the dates of contact and final responses of the 19 general automotive repair shops. The suggestions from service managers and customers in pilot testing were taken into consideration when the revising the instruments and composing the general information and directions of the final versions of the TQSIAI (Appendix H) and the two forms of the CSAI (Appendix I and J).

The final forms of the survey instruments were reviewed by the major professor and then submitted to the Human Subjects Review Committee at Iowa State University to assure the right and welfare of the human subjects were protected. The signed approval form is displayed in Appendix K.

Reliability

An internal consistency reliability analysis was employed in this research. The Cronbach alpha coefficient was used to test the reliability of both the TQSIAI and the CSAI. According to Crocker and Algina (1986): "Alpha can be used to estimate the internal consistency of items which are dichotomously scored or items which have a wide range of scoring weight, such as those on some attitude inventories or essay examinations." (p. 138).

In Hong's (1993) research "development of an instrument to measure the levels of total quality management implementation in manufacturing organizations", the reliability coefficient of the instrument was .944. The instrument used by Hong was drawn as the main reference for the item development in the TQSIAI.

Table 3.1 The results of the pilot testing by shop

Shop	Date	Result	Shop	Date	Result
1	10/16	Agreed to participate	11	10/16	Rejected to participate
	10/23	Did not finish			
	10/30	Did not finish	12	10/16	Agreed to participate
	11/11	Withdrew		10/23	Did not finish
				10/31	Did not finish
2	10/16	Rejected to participate		11/03	Returned the TQSIAI and 5 copies of the CSAI
3	10/17	Agreed to participate			
	10/24	Did not finish	13	10/16	Rejected to participate
	10/31	Withdrew			
			14	10/17	Agreed to participate
4	10/16	Agreed to participate		10/23	Did not finish
	10/23	Did not finish		10/28	Withdrew
	10/31	Did not finish			
	11/04	Returned the TQSIAI and 3 copies of the CSAI	15	10/16	Agreed to participate
				10/24	Withdrew
5	10/16	Agreed to participate	16	10/16	Agreed to participate
	10/24	Withdrew		10/23	Did not finish
				10/24	Returned the TQSIAI and 3 copies of the CSAI
6	10/17	Rejected to participate			
7	10/16	Agreed to participate	17	10/20	Agreed to participate
	10/24	Withdrew		10/26	Returned the TQSIAI and 2 copies of the CSAI
8	10/16	Rejected to participate			
			18	10/16	Rejected to participate
9	10/17	Rejected to participate			
			19	10/17	Agreed to participate
10	10/17	Agreed to participate		10/23	Did not finish
	10/23	Did not finish		11/06	Returned the TQSIAI and 3 copies of the CSAI
	10/30	Did not finish			
	11/06	Returned the TQSIAI and 6 copies of the CSAI			

Andaleeb and Basu (1994) used SEVRQUAL as a tool to investigate the level of customer satisfaction in the automotive service industry. In their research, the coefficient alpha value of the instrument was .892. The instrument of Andaleeb and Baus's research was drawn as the main reference for the item development in the CSAI.

After the data collection, the reliability coefficients of the TQSIAI and the CSAI were computed by SPSS software. Aiken (1976) suggested that if the internal consistency reliability coefficient was above .65, then the reliability of an instrument was considered sufficient. Nunnally (1978) suggested if the alpha valve was above .7, there existed appropriate internal consistency of the measures. The results of reliability analysis of the TQSIAI and the CSAI are discussed in Chapter Four.

Data Collection Procedure

There were three different colored questionnaires in this research. The yellow-colored TQSIAI was mailed directly to each of the 834 general automotive repair shop service managers in Iowa on November 12, 1997. After the managers completed the TQSIAI, they were asked to mail the questionnaires back to the researcher.

Five copies of a green-colored CSAI and five copies of a white-colored CSAI were mailed to the managers on November 12, 1997 as well. Each manager was asked to randomly choose two customers a day (one for a green-colored CSAI and the other for a white-colored CSAI). Thus, ten customers were asked to respond to the CSAI within five days at each of the general automotive repair shops.

After completing the green-colored CSAI, the customer sealed the questionnaire in the envelope provided by the researcher and returned it to the automotive repair shop

manager. The manager then mailed them back to the researcher. After completing the white-colored CSAI, the customer directly mailed back the questionnaire to the researcher . A five-dollar reward was provided after service managers mailed back TQSIAI and the green-colored CSAI. In order to increase the return rate, a follow-up notice was sent to non-respondent managers on December 1, 1997. Copies of the cover letter and follow-up letter are shown in Appendix L.

Data Analysis

The Statistical Package for the Social Sciences (SPSS, Inc., 1995) software was utilized to perform the required statistical analyses of the study. Descriptive statistics were used to measure the central tendency and variability of the respondents' demographic information. Descriptive statistics were also utilized to measure the central tendency and variability of each item, criterion, and the overall instrument. The value of Cronbach alpha coefficient was computed to determine the reliability for each criterion and for the overall instrument of the TQSIAI and the CSAI in this research. A factor analysis was conducted to evaluate the construct validity for the CSAI.

The statistical procedures used for testing the hypotheses were analysis of variance (ANOVA), multivariate analysis of variance (MANOVA), and linear-regression analysis. According to Fraenkel and Wallen (1996), the significance level should be decided by the sample size. However, when conducting inferential statistical analysis, the significance level of .01 is too tough and can lead to a Type II error, while the level of .1 is too easy a test for the null hypotheses (De Vaus, 1986). Therefore, the significance level of .05 was adopted for the statistical analyses in this research.

CHAPTER IV. RESULTS AND FINDINGS

The purpose of this chapter is to present the results from the statistical analyses of the data collected from the surveys completed by Iowa general automotive repair shop service managers and their customers. Of the 834 Total Quality System Implementation Assessment Instrument (TQSIAI) and 8340 Customer Satisfaction Assessment Instrument (CSAI) mailed to the general automotive repair shop service managers and customers, 31 TQSIAI and 107 CSAI usable questionnaires were returned and coded. The results from the analyses of these data are presented in the following order:

1. Demographics and characteristics of the samples
2. Descriptive statistics of the instruments
3. Comparison of the delivery systems of the Customer Satisfaction Assessment Instrument
4. Hypothesis testing
5. Reasons for incomplete or missing responses
6. Summary

Demographics and Characteristics of the Samples

This section presents demographic information of the samples in this research. The focus is on characteristics of the general automotive repair shop service managers and customers.

Characteristics of service managers

Information about general automotive repair shop service managers are reported under the following categories: a) gender; b) age; c) years of managerial experience in the automotive repair industry; d) education level; e) total hours of quality management training; f) automotive or quality association membership; and g) number of full-time employees in their automotive repair shops. A summary of the demographic information is presented in Table 4.1.

Gender. There were no female respondents in the survey of TQSIAI. As shown in Table 4.1, all 31 service managers were male (100%). It appears that males dominate the automotive repair industry.

Age. Because of the large range of ages (from 33 to 61) of the general automotive repair shop service managers, the mean, median, and standard deviation are reported (Table 4.1). Figure 4.1 shows a histogram of the ages of the service managers. From the distribution curve we can see that there is a reasonable bell shape. This variable may validate the assumption of normal distribution. The mean age of the service managers was 45.3 years.

Managerial experience. Due to the wide spread of years (from 2 to 39) of the general automotive repair shop service managers' managerial experience, the mean, median, and standard deviation are reported (Table 4.1). Figure 4.2 displays a histogram of the years of managerial experience for the service managers. From the distribution curve we can see there is an asymmetric bell shape and a tail toward the larger values. This indicates a less appropriate approximation to a normal distribution than is true for managers' ages. The mean of the managers' managerial experience was about 11 years.

Table 4.1 Demographics of the general automotive repair shop service managers

Category		Frequency	Percent	Mean	Median	Std. Dev.
Gender	Female	0	0.0			
	Male	31	100.0			
	Missing	0	0.0			
	Total	31	100.0			
Age	Valid	31		45.32	43.00	9.03
	Missing	0				
	Total	31				
Managerial experience	Valid	31		10.97	8.00	9.06
	Missing	0				
	Total	31				
Education level	High school or below	11	35.5			
	Two-year college	12	38.7			
	Four-year college	5	16.1			
	Graduate school	0	0.0			
	Other	0	0.0			
	Missing	3	9.7			
	Total	31	100.0			
Quality management training	Valid	28		37.46	20.00	45.02
	Missing	3				
	Total	31				
Association membership	Yes	21	67.7			
	No	10	32.3			
	Missing	0	0.0			
	Total	31	100.0			
Number of full-time employees	Valid	31		8.58	4.00	9.31
	Missing	0				
	Total	31				

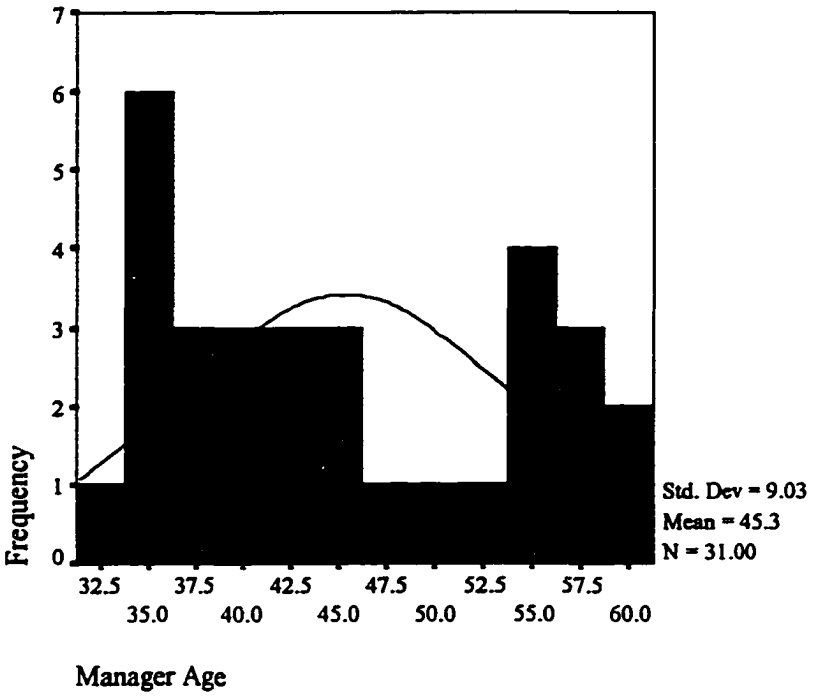


Figure 4.1 The histogram of the service managers' age

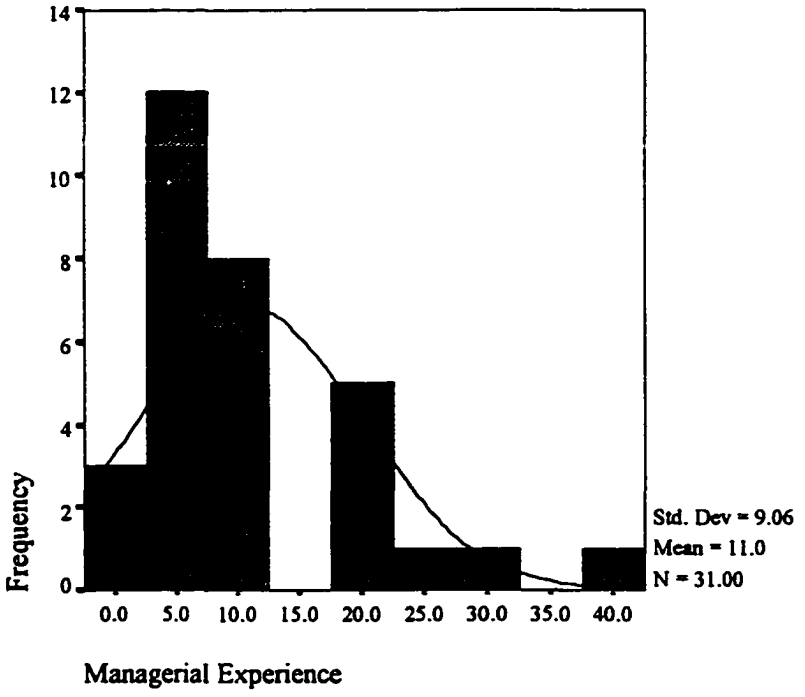


Figure 4.2 The histogram of the service managers' years of managerial experience

Education level. The highest education level attained by the general automotive repair shop service managers is presented in five categories: 1) high school or below; 2) two-year college; 3) four-year college; 4) graduate school; and 5) other. In Table 4.1 we can see the distribution of the service managers' education level. The majority of respondents graduated from a two-year college (38.7%), followed by a high school or below (35.5%). About 16% of the managers completed a four-year college program. None of them reported receiving a graduate degree. This might suggest that a high level of education was not common in the automotive repair industry management.

Quality management training. In Table 4.1, the service managers' total number of hours of quality management training is displayed. Due to a wide spread of total hours (from 0 to 200) in the service managers' training experience, the mean, median, and standard deviation are reported. Figure 4.3 displays a histogram of the total hours of quality management training for the service managers. From the distribution curve we can see there is not a symmetric bell shape and there is a tail toward the larger values. The assumption of a normal distribution does not seem appropriate. The mean of the managers' quality management training was about 37.5 hours.

As summarized in Table 4.2, a linear regression test of the relationship between the total hours of service managers' quality management training and the number of full-time employees in the general automotive repair shops attains significance ($p \leq .000$). The t-value of the regression model is equal to 4.639. It appears that service managers in larger automotive repair shops participated in more quality management training sessions.

Table 4.2 Linear regression of total hours of service managers' quality management training and the number of full-time employees

S. V.	S. S.	D. F.	M. S.	t	F	Sig. of F
Regression	25092.9	1	25092.9	4.693	22.020	000*
Residual	29628.1	26	1139.542			
Total	54721.0	27				

*significant at .05.

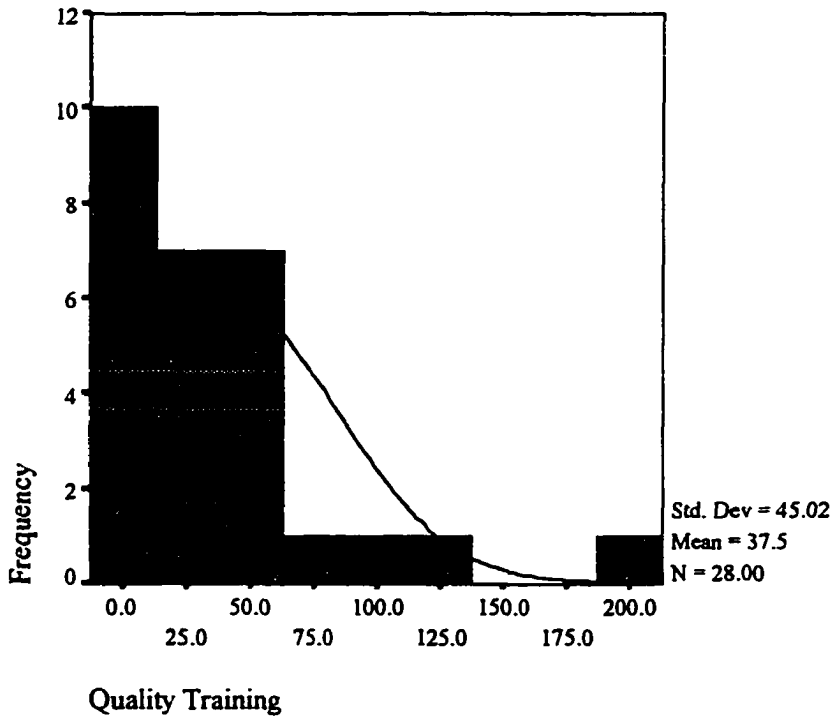


Figure 4.3 The histogram of the service managers' total hours of quality management training

Association membership. In Table 4.1, 67.7% of the general automotive repair shop service managers reported memberships in automotive or quality associations. Fewer than one-third of the managers (32.3%) were not members of any automotive or quality association.

Number of full-time employees. Due to the large range of the number of full-time employees (from 1 to 36) in the responding general automotive repair shops, the mean, median, and standard deviation are reported (Table 4.1). Figure 4.4 shows a histogram of the number of full-time employees for the general automotive repair shops. The mean number of full-time employees was approximately 8.5. From the distribution curve we can see that there is an asymmetric bell shape and a tail toward the larger values. This indicates a skewed distribution. The skewed nature of the sample might reflect the skewed nature of the population in the number of the full-time employees. Table 4.3 lists the distribution of the number of full-time employees in the general automotive repair shops in Iowa.

Table 4.3 The distribution of the number of full-time employees in general automotive repair shops in Iowa

Number of full-time employees	sample	%	Population	%
1-4	16	51.6	655	78.5
5-9	6	19.4	134	16.1
10-19	5	16.1	36	4.3
20-49	4	12.9	9	1.1

(U. S. Department of Commerce, 1996, p 8)

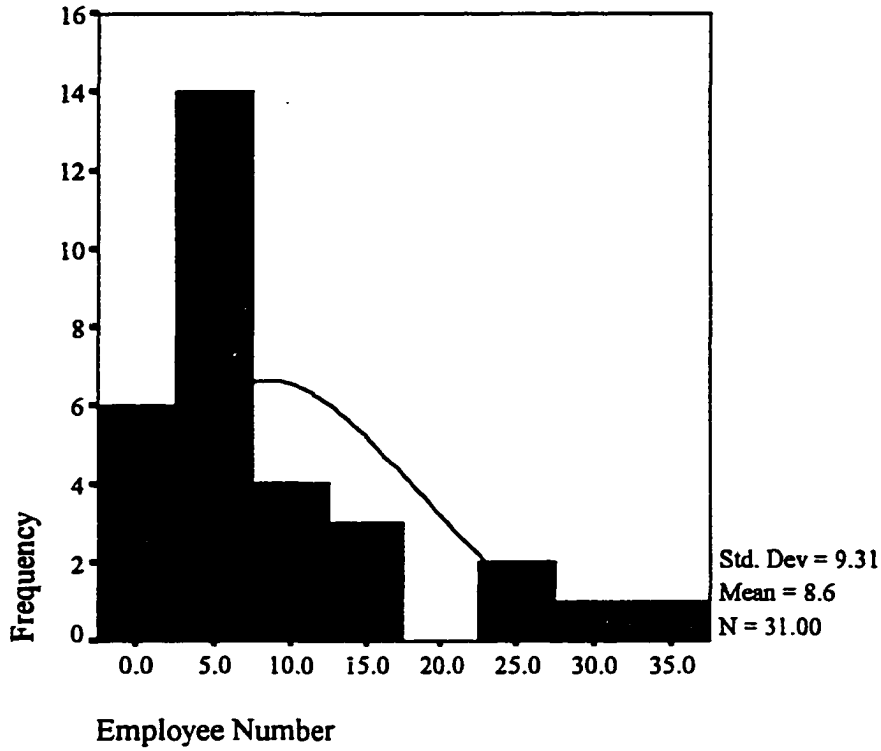


Figure 4.4 The histogram of the general automotive repair shops' number of full-time employees

Characteristics of customers

The primary purpose of this section is to describe the general automotive repair shop customers using the following demographic variables: a) gender; b) age; c) education level; d) annual family income; e) cost of service; and f) age of vehicle. The demographic information is presented in Table 4.4.

Gender. The number of male customers totaled 71 (66.4%), while the number of female customers was 36 (33.6%). The number of male customers was slightly less than twice the number of female customers (Table 4.4).

Table 4.4 Demographics of the general automotive repair shop customers

Category		Frequency	Percent	Mean	Median	Std. Dev.
Gender	Female	36	33.6			
	Male	71	66.4			
	Missing	0	0.0			
	Total	107	100.0			
Age	Valid	105		45.61	44.00	16.20
	Missing	2				
	Total	107				
Education level	High school or below	47	44.7			
	Two-year college	17	16.5			
	Four-year college	20	19.4			
	Graduate school	19	18.4			
	Other	0	0.0			
	Missing	4	3.7			
	Total	107	100.0			
Annual family income	Below 20,000	15	14.0			
	20,001–30,000	18	16.8			
	30,001–40,000	21	19.6			
	40,001–50,000	20	18.7			
	50,001–60,000	10	9.3			
	60,001–70,000	7	6.5			
	70,001–80,000	4	3.7			
	80,001 and over	7	6.5			
	Missing	5	4.7			
	Total	107	100.0			
Cost of service	Valid	104		250.81	146.00	390.31
	Missing	3				
	Total	107				
Age of vehicle	Valid	107		5.22	5.00	3.14
	Missing	0				
	Total	107				

Age. The mean, median, and standard deviation of the general automotive repair shop customers' ages are reported (Table 4.4). Figure 4.5 shows a histogram of the customers' ages. From the distribution curve we can see that there is a reasonable bell shape. The mean of the customers' ages was about 45.6 years.

Education level. The highest education level attained by the general automotive repair shop customers is presented in five categories: 1) high school or below; 2) two-year college; 3) four-year college; 4) graduate school; and 5) other. In Table 4.4, the largest category included 47 (44.7%) who had completed a high school degree, 20 (19.4%) had a four-year college degree, and 19 (18.4%) had a graduate degree. The smallest category represented those who had completed a two-year college degree, with the number equaling 17 (16.5%).

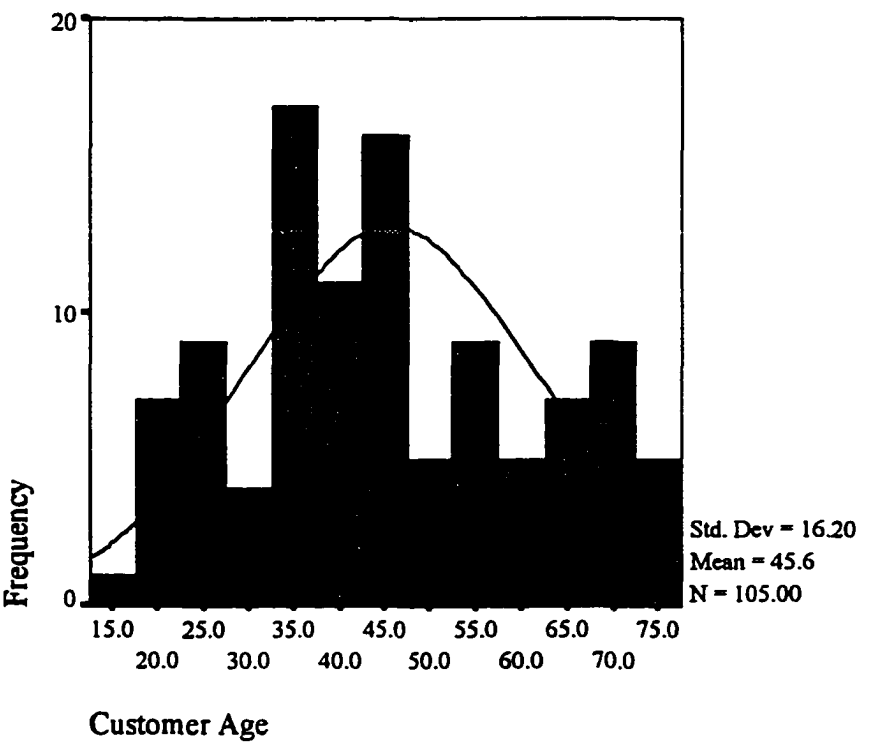


Figure 4.5 The histogram of the customers' age

Annual family income. The annual family income of the customers was grouped under eight categories: 1) below $20,000; 2) $20,001-$30,000; 3) $30,001-$40,000; 4) $40,001-$50,000; 5) $50,001-$60,000; 6) $60,001-$70,000; 7) $70,001-$80,000; and 8) $80,001 and over. In Table 4.4, 19.6% of the respondents had an annual family income between $30,001 and $40,000, and 18.7% between $40,001 and $50,000. About 10% of the respondents had an annual family income over $70,000. Five customers did not respond to this item.

Cost of service. Due to a wide range of repair costs (from 0 to 2864) of automotive repair service, the mean, median, and standard deviation are reported (Table 4.4). Figure 4.6 is a histogram of the cost of service paid by the customers. From the distribution curve we

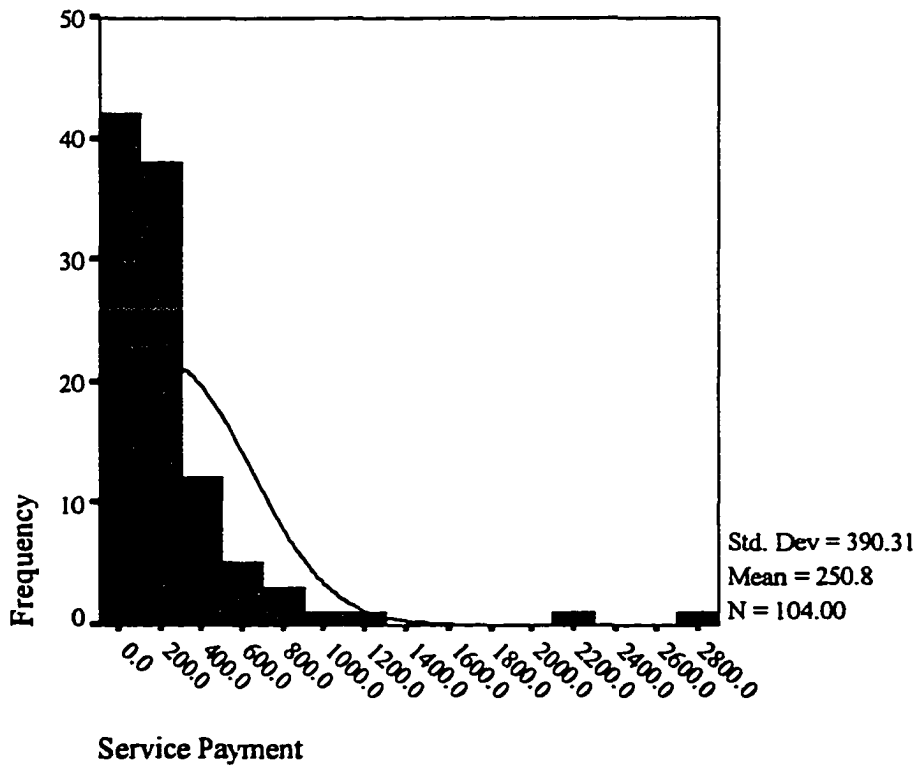


Figure 4.6 The histogram of cost of repair service paid by the customers

see a badly skewed distribution, with a tail toward the larger values. The mean cost of the automotive repair service was approximately $250.

As summarized in Table 4.5, a linear regression analysis of the relationship between the cost of the automotive repair service and the age of the serviced vehicle attains significance ($p \leq .023$). The t-value of the regression model is equal to 2.303. It seems that the older the vehicle, the higher the repair cost.

Age of vehicle. In Table 4.4, the mean age of the serviced vehicles was about 5.2 years. Because of the large range of the ages (from 1 to 18) of the serviced vehicles, the mean, median, and standard deviation are reported (Table 4.4). Figure 4.7 displays a histogram of the ages of the serviced vehicles. From the distribution curve one can see that a symmetric bell shape is apparent. This indicates that the assumption of a normal distribution of the ages of serviced vehicles was not violated.

Table 4.5 Linear regression of the cost of repair service and the ages of service vehicles

S. V.	S. S.	D. F.	M. S.	t	F	Sig. of F
Regression	775345	1	775345	2.303	5.302	.023*
Residual	1.5+07	102	146236			
Total	1.6+07	103				

*significant at .05.

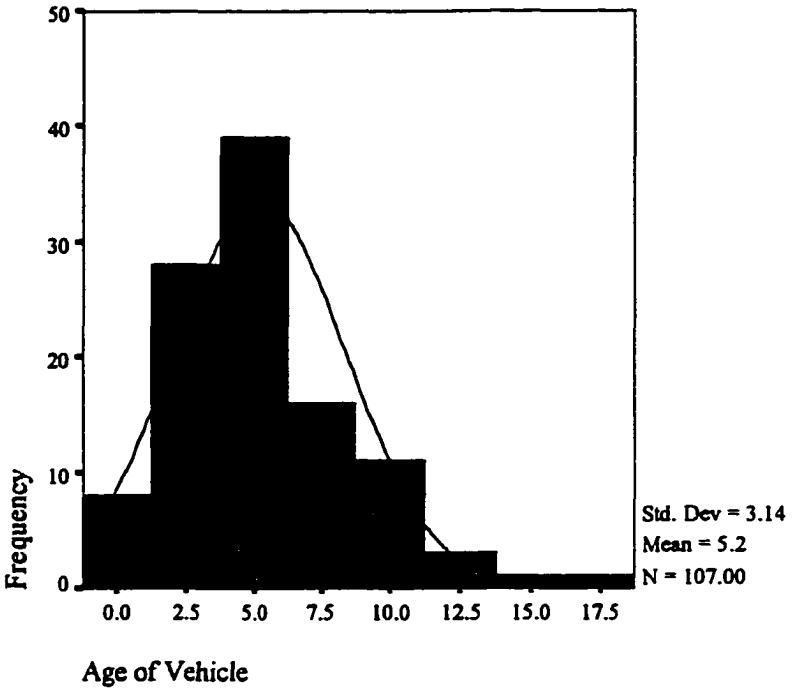


Figure 4.7 The histogram of ages of serviced vehicles

Descriptive Statistics of the Instruments

The purpose of this section is to present the results of an analysis of the descriptive statistics, including the mean and standard deviation of each item and criterion in the TQSIAI and CSAI. The reliability of each criterion and instrument is also presented along with a factor analysis of the CSAI.

Table 4.6 lists the means and standard deviations of each item on the TQSIAI. The item with the highest mean value is item 27 (4.50), then item 7 (4.42), item 9 (4.35), and item 16 (4.35). The item with the lowest mean value is item 12 (3.03), then item 4 and 35 (3.13).

A reliability estimate of the TQSIAI is presented in Appendix M. Table 4.7 displays the summary of this reliability analysis. Cronbach alpha reliability coefficients of the seven

Table 4.6 Descriptive statistics of items of the Total Quality System Implementation Assessment Instrument

Item	Valid N	Mean	Std. Dev.	Item	Valid N	Mean	Std. Dev.
1	31	4.29	.53	19	31	3.61	1.02
2	31	4.13	.72	20	31	3.55	1.18
3	31	4.26	.63	21	31	3.77	.72
4	31	3.13	.96	22	31	3.77	.99
5	31	3.26	1.18	23	31	3.65	1.11
6	31	3.45	1.41	24	31	4.00	.97
7	31	4.42	.76	25	31	3.58	1.06
8	31	4.23	.56	26	31	3.87	.81
9	31	4.35	.61	27	30	4.50	.68
10	31	3.74	1.09	28	30	3.27	1.36
11	31	4.19	.54	29	30	4.07	1.20
12	30	3.03	1.10	30	31	3.87	1.23
13	31	4.26	.73	31	31	4.03	.88
14	31	4.10	.94	32	31	3.61	1.05
15	31	4.19	.48	33	31	3.42	1.02
16	31	4.35	.61	34	31	3.71	1.32
17	31	4.06	.81	35	31	3.13	1.43
18	31	3.48	.81				
Total	31	3.84	.49				

Table 4.7 Reliability analysis of the Total Quality System Implementation Assessment Instrument

Category	Item	N	Mean	Std. Dev.	Reliability
Leadership	1 – 5	31	3.81	.55	.66
Customer satisfaction	6 – 10	31	4.04	.60	.62
Empowerment	11 – 15	31	3.96	.44	.43
Continuous improvement	16 – 20	31	3.81	.56	.58
Accountability	21 – 25	31	3.75	.57	.51
Communication	26 – 30	31	3.90	.77	.79
Training	31 – 35	31	3.58	.87	.81
Total	1 – 35	31	3.84	.49	.92

criteria range from .43 to .81. The overall instrument reliability is .92. The lower reliability of the seven criteria may be attributed to fewer items in the analyses.

The mean of each criterion reflects that the general automotive repair shop service managers possessed more positive attributes on the criterion of customer satisfaction (4.04) than on the criteria of empowerment (3.96), communication (3.90), leadership (3.81), continuous improvement (3.81), accountability (3.75), and training (3.58). The mean of the overall instrument is 3.84.

Table 4.8 lists the mean and standard deviation for each item in the CSAI. The item with the highest mean value is item 10 (4.36), then item 23 (4.25), and item 13 (4.22). The item with the lowest mean value is item 25 (3.45), then item 1 (3.49), and item 2 (3.64).

A reliability analysis of the CSAI is presented in Appendix N. Table 4.9 displays the summary of the analysis. Cronbach alpha reliability coefficients for the five criteria range from .67 to .85. The overall instrument reliability is .92.

In Table 4.9 the mean of each criterion reflects that the general automotive repair shop customers possessed more positive attitudes on the criterion of empathy (4.13) than on the criteria of responsiveness (4.11), convenience (4.08), reliability (4.05), or fairness (3.82). The mean of the overall CSAI is 4.04.

A factor analysis was utilized to detect if responses to the items on the CSAI were consistent with the five categories used to structure the SERVQUAL. With missing values substituted by the mean, a principal components factor analysis was conducted and followed by a varimax rotation (Appendix O). The results are summarized in Table 4.10, and seven

Table 4.8 Descriptive statistics of items of the Customer Satisfaction Assessment Instrument

Item	Valid N	Mean	Std. Dev.	Item	Valid N	Mean	Std. Dev.
1	107	3.49	.86	**14**	107	4.14	.76
2	107	3.64	.90	**15**	107	3.90	.88
3	106	3.86	.82	**16**	107	4.03	.76
4	107	4.17	.79	**17**	106	3.92	.85
5	107	3.96	.81	**18**	107	4.04	.71
6	107	4.14	.89	**19**	107	4.09	.69
7	107	4.11	.78	**20**	107	4.18	.76
8	107	4.02	.72	**21**	107	4.10	.78
9	107	4.04	.70	**22**	107	4.15	.87
10	107	4.36	.73	**23**	106	4.25	.68
11	106	4.10	.72	**24**	107	3.81	.99
12	106	4.20	.75	**25**	107	3.45	.98
13	107	4.22	.79				
Total	107	4.04	.47				

Table 4.9 Reliability analysis of the Customer Satisfaction Assessment Instrument

Category	Item	N	Mean	Std. Dev.	Reliability
Fairness	1 – 5	107	3.82	.66	.85
Empathy	6 – 10	107	4.13	.60	.83
Responsiveness	11 – 15	107	4.11	.56	.77
Reliability	16 – 20	107	4.05	.52	.71
Convenience	21 – 25	107	4.08	.58	.67
Total	1 – 25	107	4.04	.47	.92

Table 4.10 Factor analysis of the Customer Satisfaction Assessment Instrument

Factor	Eigenvalue	% Variance	Cumulative %
1	8.76	35.0	35.0
2	1.66	6.6	41.7
3	1.55	6.2	47.9
4	1.33	5.3	53.2
5	1.25	5.0	58.3
6	1.18	4.7	63.0
7	1.11	4.4	67.4

possible factors are suggested with eigenvalues greater than 1.00. The seven factors explained 67% of the total variance on the scales of the CSAI.

Table 4.11 displays the items from each criterion in the CSAI as it pertains to the empirical factors. The criterion of fairness (items 1-5) seems to load on factor 2. The criterion of empathy (items 6-10) seems to load on factor 1. The criterion of responsiveness seems to load on factor 5 (items 13 and 14) and on factor 6 (items 12 and 15). The criterion of reliability (items 16-19) seems to load on factor 3. The criterion of convenience (items 21, 22, 23, and 25) seems to load on factor 4. There are three items (11, 20, and 24) that appear to not fit their original dimensions as structured in the SERVQUAL.

A factor analysis of the five items from each of the five criteria in the CSAI was conducted (Appendix O). The results are summarized in Table 4.12. An examination of factor matrices suggests that the items from the same criterion load on a single factor. Each item has a single factor loading from .54 to .87 of the variation, and each criterion was explained from 45% to 62% of the variation by a related factor.

From the previous discussion, the factor analysis of the CSAI reveals that the criterion of responsiveness might load on two factors, and three items do not fit their original determined criteria. However, the items in each criterion form a single factor. This provides empirical evidence of the construct validity of the CSAI.

Table 4.11 Comparison of items in each of the five Customer Satisfaction Assessment Instrument criteria with empirical factors

Criterion	Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Fairness	1-5		5					
Empathy	6-10	5						
Responsiveness	11-15				1	2	2	
Reliability	16			4		1		
Convenience	21				4			1

Table 4.12 Factor analysis of the five criteria of the Customer Satisfaction Assessment Instrument

Criterion	Item	Loading Range	Eigenvalue	% Variance
Fairness	1-5	.74 to .87	3.12	62.4
Empathy	6-10	.75 to .80	3.02	60.4
Responsiveness	11-15	.58 to .77	2.61	52.1
Reliability	16-20	.54 to .79	2.37	47.4
Convenience	21-25	.56 to .77	2.26	45.1

Comparison of Delivery Systems of the Customer Satisfaction Assessment Instrument

The purpose of this section is to compare the results of customer satisfaction surveys regarding the two different delivery systems discussed in the section on data collection in Chapter Three. In Table 4.13, six analyses of variance (ANOVA) were conducted for the purposes of this comparison. The dependent variables were the mean scores of the five criteria and the overall instruments of the CSAI. The independent variable was the nominal categorization of the two different delivery systems.

All the tests failed to attain significance when the α was set at .05. This indicates that there was no difference in the level of customer satisfaction as a function of the two different delivery systems.

Hypothesis Testing

The purpose of this section is to present the results of the hypothesis testing. There are 11 hypotheses that were tested in this research. Hypotheses one to five explore the relationships between the level of TQM implementation and the background information of the general automotive repair shop service managers. Hypotheses six to nine test the relationships between the level of customer satisfaction and certain demographic variables of the general automotive repair shop customers. Hypothesis 10 discusses the relationship between the seven TQM implementation criteria and the five customer satisfaction criteria. Hypothesis 11explores the relationship between the overall level of TQM implementation and customer satisfaction. Linear regression analysis, analysis of variance (ANOVA), and multivariate analysis of variance (MANOVA) were used to test these hypotheses.

Table 4.13 Analysis of variance (ANOVA) of customer satisfaction by the instrument delivery systems

S. V.	S. S.	D. F.	M. S.	F	Sig. of F
Fairness					
Between Groups	.310	1	.310	.706	.403
Within Groups	46.105	105	.439		
Total	46.415	106			
Empathy					
Between Groups	.0052	1	.052	.152	.698
Within Groups	37.621	105	.358		
Total	37.676	106			
Responsiveness					
Between Groups	.105	1	.105	.329	.567
Within Groups	33.363	105	.318		
Total	33.468	106			
Reliability					
Between Groups	.0040	1	.040	.151	.699
Within Groups	28.147	105	.268		
Total	28.187	106			
Convenience					
Between Groups	.335	1	.335	.980	.324
Within Groups	35.907	105	.342		
Total	36.242	106			
Customer satisfaction					
Between Groups	.0000018	1	.310	.000	.993
Within Groups	23.090	105	.439		
Total	23.090	106			

Hypothesis 1. There is no significant difference in the level of TQM implementation among the general automotive repair shops in IOWA due to the service managers' ages and education levels.

This hypothesis examined whether service managers' ages and education levels affected the level of TQM implementation in their general automotive repair shops. An analysis of variance (ANOVA) and a linear regression analysis were conducted to test this hypothesis. The dependent variable was the mean score of the TQSIAI. The independent variables were the service manager's age and education level..

The results of statistical analyses were summarized in Table 4.14. Both tests did not attain significance by setting α equal to .05. We may say that service managers' ages and education levels did not significantly affect the level of TQM implementation in their general automotive repair shops.

Table 4.14 Analysis of variance (ANOVA) of TQM implementation by the service managers' ages and education levels

	S. V.	S. S.	D. F.	M. S.	F	Sig. of F
Age	Regression	.150	1	.150	.607	.442
	Residual	7.165	29	.247		
	Total	7.315	30			
Education level	Between Groups	.062	2	.031	.110	.896
	Within Groups	7.022	25	.281		
	Total	7.840	27			

Hypothesis 2. There is no significant difference in the level of TQM implementation among the general automotive repair shops due to the years of service managers' managerial experience.

This hypothesis examined the relationship between the years of service managers' managerial experience and the level of TQM implementation in their respective general automotive repair shops. A linear regression analysis was conducted to test the hypothesis. The dependent variable was the mean score of the TQSIAI. The independent variable was the years of service managers' managerial experience.

In Table 4.15, the test result attains significance ($p \leq .017$). The R-square value equals .181 and the adjusted R-square value equals .153 (Table 4.16). Moreover, the scatter plot of TQM implementation by the standardized residuals appears to form a linear pattern (Figure 4.8). This indicates that there appears to be a relationship between the two tested variables.

In Figure 4.9, the Q-Q plot of the standardized residuals does not have a straight-line appearance. This indicates that the normality assumption is not held. However, there are only 31 cases in this analysis. When the sample is small and the normality assumption is not badly violated, the results of the regression analysis will not be affected seriously (Norusis, 1995).

In Table 4.16, the Durbin-Watson statistic value equals 1.733. The independent assumption is held by testing the Durbin-Watson statistic value. In Figure 4.10, however, the variability of the studentized deleted (press) residuals is increasing with the increasing standardized predicted values. This suggests that the constant variance assumption for this linear-regression model is violated.

In conclusion, the test result violates the constant variance assumption. This indicates that the regression model does not fit very well. However, from the scatter-plot of TQM

implementation by the standardized residuals (Figure 4.8), it appears that a linear relationship between the dependent and independent variables exists. Moreover, the linear regression analysis attains significance with a negative slope (t-value equal to -2.532). We may say that the null hypothesis is rejected. It seems that the more managerial experience the service manager has, the lower level of TQM implementation in their general automotive repair shops.

Table 4.15 Linear regression of TQM implementation and the years of service managers' managerial experience

S. V.	S. S.	D. F.	M. S.	t	F	Sig. of F
Regression	1.324	1	1.324	-2.532	6.410	.017*
Residual	5.991	29	.207			
Total	7.315	30				

*Significant at .05.

Table 4.16 R-square, adjusted R-square, and Durbin-Watson values in the linear regression of TQM implementation and the years of service managers' managerial experience

	Model				
Dependent Variable	Independent Variable	R	R-Square	Adjusted R-Square	Durbin-Watson
TQM implementation	Years of service managers' managerial experience	.425	.181	.153	1.733

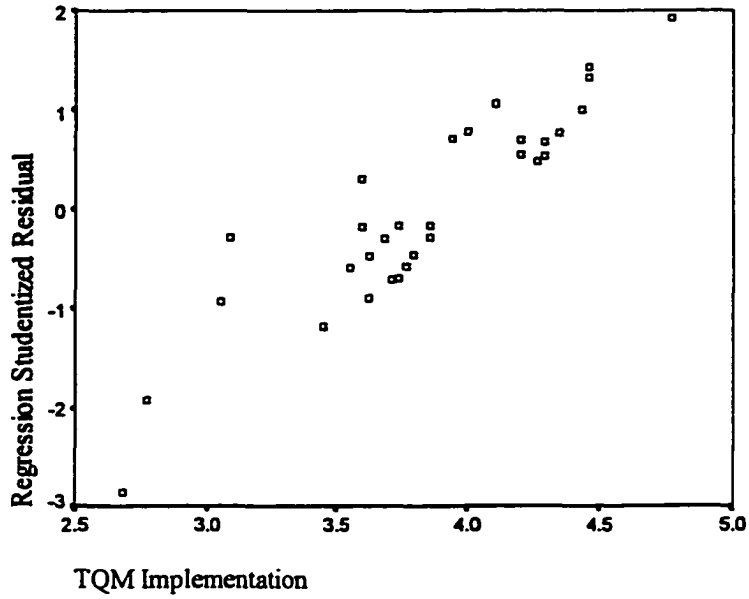


Figure 4.8 The scatter plot of TQM implementation and the years of service managers' managerial experience

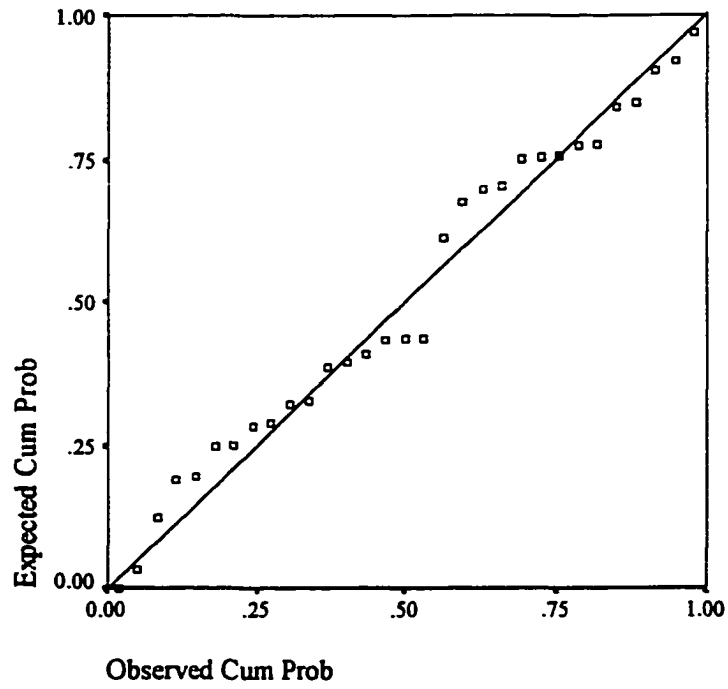


Figure 4.9 The Q-Q plot of TQM implementation and the years of service managers' managerial experience

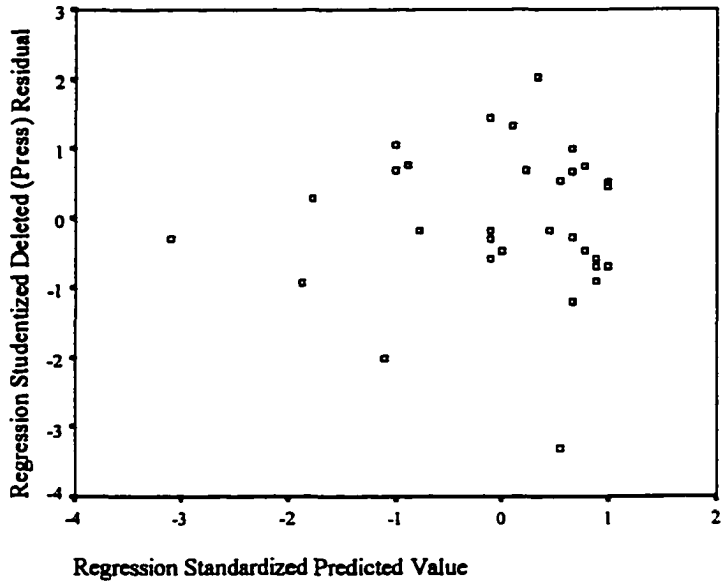


Figure 4.10 The studentized residuals plot of TQM implementation and the years of service managers' managerial experience

Hypothesis 3. There is no significant difference in the level of TQM implementation among the general automotive repair shops due to the total hours of service managers' quality management training.

This hypothesis examined the relationship between the total hours of service managers' quality management training and the level of TQM implementation in their respective general automotive repair shops. A linear regression analysis was conducted to test the hypothesis. The dependent variable was the mean score of the TQSIAI. The independent variable was the total hours of quality management training possessed by the service manager.

In Table 4.17, the test result attains significance ($p \leq .011$). The R-square value equals .226 and the adjusted R-square value equals .196 (Table 4.18). Moreover, the scatter plot of the dependent variable by the standardized residuals appears to form a linear pattern (Figure 4.11). This indicates that there might be a relationship between the two tested variables.

In Figure 4.12 the Q-Q plot of the standardized residuals does not have a straight-line appearance. This might indicate that the normality assumption is not valid. In Figure 4.13, the variability of the studentized deleted (press) residuals keeps stable with the increasing standardized predicted values. This might indicate that the constant variance assumption is held. However, in Table 4.18 the Durbin-Watson statistic value equals 1.394. This indicates that the independent observation assumption is violated.

In conclusion, the test results violate the assumptions of normality and independence. This indicates that the regression model does not fit very well. However, from the scatter plot of TQM implementation by the standardized residuals (Figure 4.11), it appears a linear relationship between the dependent variable and the independent variable. Moreover, the linear regression analysis attains significance with a positive slope (t-value equal to 2.755). We may say that the null hypothesis is rejected. It seems that the more quality management training possessed by a service manager, the higher level of TQM implementation in their respective general automotive repair shop.

Table 4.17 Linear regression of TQM implementation and the total hours of service managers' quality management training

S. V.	S. S.	D. F.	M. S.	t	F	Sig. of F
Regression	1.604	1	1.604	2.755	7.589	.011*
Residual	5.490	26	.211			
Total	7.094	27				

significant at .05.

Table 4.18 R-square, adjusted R-square, and Durbin-Watson values in the linear regression of TQM implementation and the total hours of service managers' quality management training

Model					
Dependent Variable	Independent Variable	R	R-Square	Adjusted R-Square	Durbin-Watson
TQM implementation	Total hours of service managers' quality management Training	.476	.226	.196	1.394

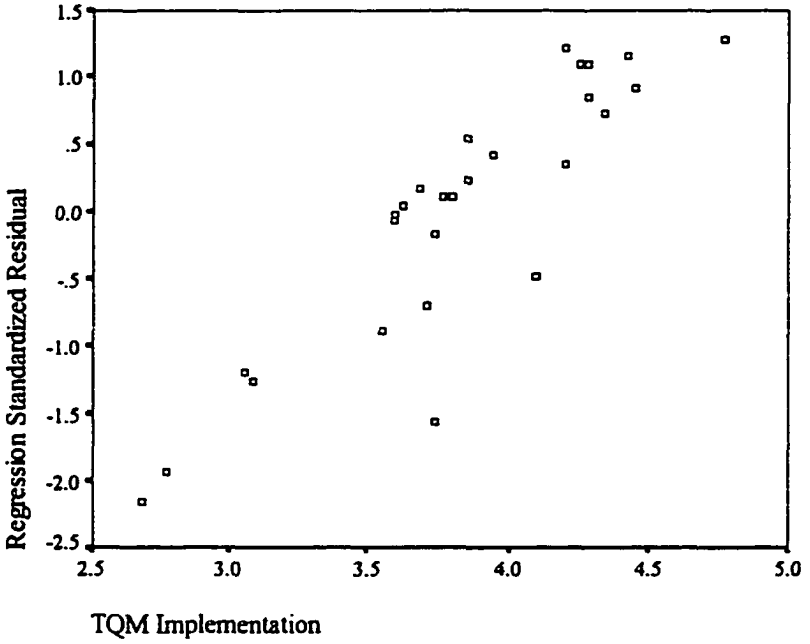


Figure 4.11 The scatter plot of TQM implementation and the total hours of service managers' quality management training

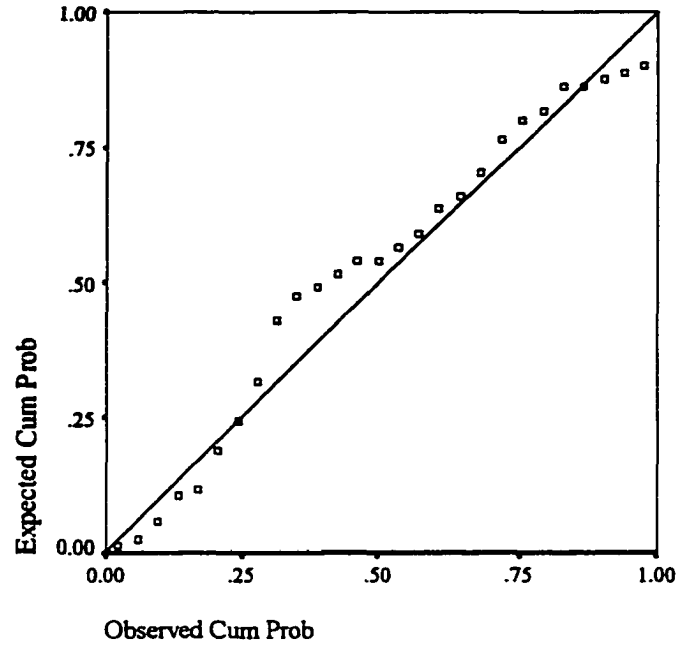


Figure 4.12 The Q-Q plot of TQM implementation and the total hours of service managers' quality management training

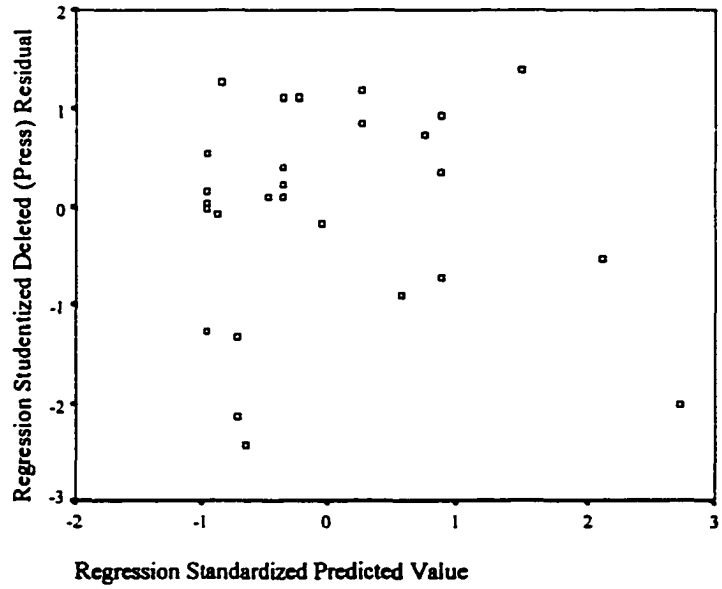


Figure 4.13 The studentized residuals plot of TQM implementation and the total hours of service managers' quality management training

Hypothesis 4. There is no significant difference in the level of TQM implementation among the general automotive repair shops due to service managers' association membership.

This hypothesis examines whether the service managers' memberships in automotive or quality associations (for example, Automotive Service Association, Society of Automotive Engineering, American Society for Quality, etc.) affected the level of TQM implementation in their respective general automotive repair shop. An analysis of variance (ANOVA) was conducted to test the hypothesis. The dependent variable was the mean score of the TQSIAI. The independent variable was the nominal category of the manager's association membership.

The test fails to attain the level of significance by setting α equal to .05 (Table 4.19). We may say that service managers' automotive or quality association memberships do not affect the TQM implementation in their general automotive repair shops.

Hypothesis 5. There is no significant difference in the level of TQM implementation among different sizes of the general automotive repair shops.

This hypothesis examines whether the number of full-time employees affected the level of TQM implementation in the general automotive repair shops. A linear regression analysis was conducted to test the hypothesis. The dependent variable was the mean score of the TQSIAI. The independent variable was the number of full-time employees.

In Table 4.20, the test result attains significance ($p \leq .015$). The R-square value equals .187 and the adjusted R-square value equals .159 (Table 4.21). Moreover, the scatter plot of the dependent variable by the standardized residuals appears to follow a linear pattern (Figure 4.14). This indicates that there might be a relationship between the two tested variables.

In Figure 4.15 the Q-Q plot of the standardized residuals does not have a straight-line appearance. This suggests that the normality assumption is not held. In Table 4.21 the

Table 4.19 Analysis of variance (ANOVA) of TQM implementation by the service managers' association membership

S. V.	S. S.	D. F.	M. S.	F	Sig. of F
Between Groups	.505	1	.505	2.150	.153
Within Groups	6.810	29	.235		
Total	7.315	30			

Table 4.20 Linear regression of TQM implementation and the number of full-time employees

S. V.	S. S.	D.F.	M. S.	t	F	Sig. of F
Regression	1.370	1	1.370	2.585	6.680	.015*
Residual	5.946	29	.205			
Total	7.315	30				

* significant at .05.

Durbin-Watson statistic value equals 1.657. The independence observation assumption is held by testing the Durbin-Watson statistic value.

In Figure 4.16, however, the variability of the studentized deleted (press) residuals is decreasing with the increasing standardized predicted values. This suggests that the assumption of constant variance is violated. The reason might be that there are fewer cases on larger observation values.

In conclusion, the test result might violate the assumption of constant variance. However, in Figure 4.14, a linear relationship appears to exist between the dependent variable

Table 4.21 R-square, adjusted R-square, and Durbin-Watson values in the linear regression of TQM implementation and the number of full-time employees

Model					
Dependent Variable	Independent Variable	R	R-Square	Adjusted R-Square	Durbin-Watson
TQM Implementation	Number of full-time employees	.433	.187	.159	1.657

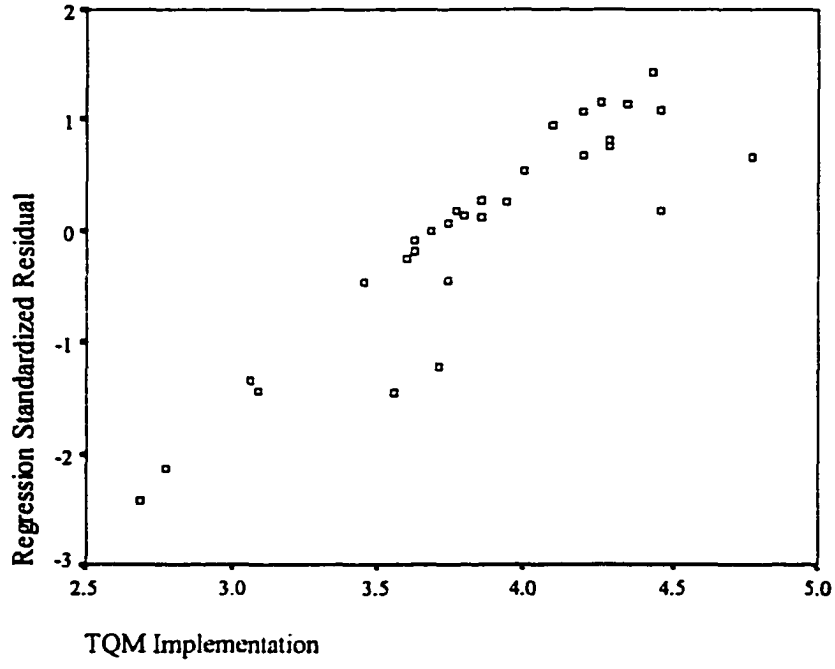


Figure 4.14 The scatter plot of TQM implementation and the number of full-time employees

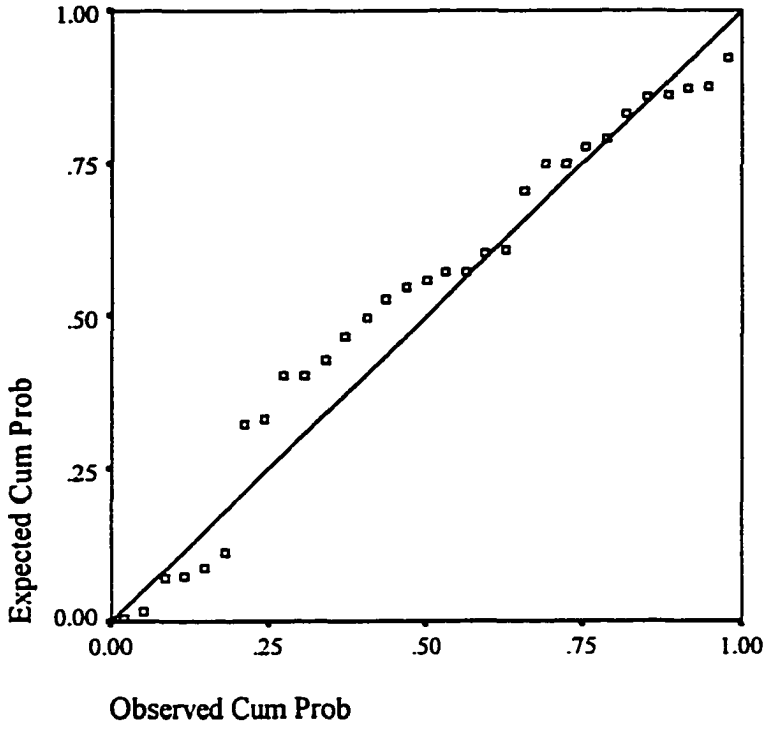


Figure 4.15 The Q-Q plot of TQM implementation and the number of full-time employees

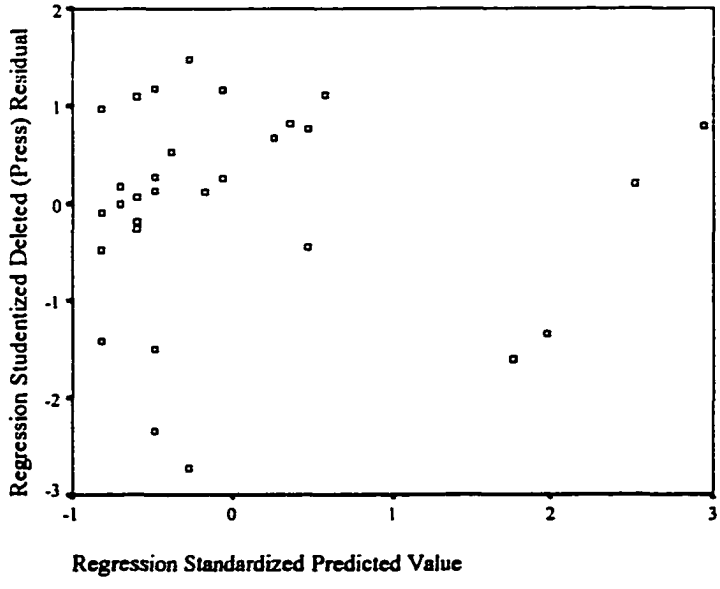


Figure 4.16 The studentized residuals plot of TQM implementation and number of full-time employees

and the independent variable. The linear regression analysis attains the level of significance with a positive slope (t-value equal to 2.585). We may say that the null hypothesis is rejected. It seems that the larger the number of full-time employees, the higher the level of TQM implementation in the general automotive repair shops.

A correlation analysis was conducted to investigate the relationship between the variables in the TQSIAI. The result of the analysis is summarized in Table 4.22. The service managers' ages had a positive relationship with the service managers' managerial experience. The service managers' managerial experience positively affected the level of continuous improvement, communication, training, and the overall TQM implementation. The service managers' total hours of quality management training had a positive relationship with the number of full-time employees, and it positively influenced the level of continuous improvement, training, and the overall TQM implementation. The number of full-time employees also positively affected the level of leadership, training, and the overall TQM implementation in the general automotive repair shops.

A step-wise linear regression analysis was conducted to examine the relationship between TQM implementation and the three independent variables (number of full-time employees, service managers' managerial experience, and service managers' quality management training) in the general automotive repair shops. The result presented in Appendix P revealed that the service managers' managerial experience and quality management training explained 40.6% of the variation on TQM implementation in the general automotive repair shops. However, the variable of number of full-time employees was eliminated in this regression model.

Table 4.22 Correlation matrix of the Total Quality System Implementation Assessment Instrument

	Age	Managerial experience	Education level	Quality training	Association membership	Employee number	Leadership
Age	1.000						
Managerial experience	.638* (.000)	1.000					
Education level	-.109	-.078	1.000				
Quality training	.040	-.098	.146	1.000			
Association membership	.045	.049	-.324	-.318	1.000		
Employee number	-.168	-.174	.002	.677* (.000)	-.172	1.000	
Leadership	-.037	-.148	-.203	.369	-.350	.242	1.000
Customer satisfaction	-.157	-.197	.047	.310	-.069	.502* (.004)	.326
Empowerment	.035	-.205	-.080	.286	-.134	.143	.586* (.001)
Continuous improvement	-.098	-.447* (.012)	-.044	.517* (.005)	-.370* (.041)	.289	.614* (.000)
Accountability	-.015	-.073	.108	.340	-.068	.241	.585* (.001)
Communication	-.213	-.626* (.000)	.172	.278	-.245	.316	.520* (.003)
Training	-.194	-.467* (.008)	-.065	.515* (.005)	-.209	.524* (.002)	.637* (.000)
Total	-.143	-.425* (.017)	-.001	.476* (.011)	-.263	.433* (.015)	.762* (.000)

* Significant at .05.

Table 4.22 (continued)

	Customer satisfaction	Empowerment	Continuous improvement	Accountability	Communication	Training	Total
Age							
Managerial experience							
Education level							
Quality training							
Association membership							
Employee number							
Leadership							
Customer satisfaction	1.000						
Empowerment	.303	1.000					
Continuous improvement	.581* (.001)	.557* (.001)	1.000				
Accountability	.523* (.003)	.471* (.007)	.583* (.001)	1.000			
Communication	.498* (.004)	.523* (.003)	.740* (.000)	.491* (.005)	1.000		
Training	.505* (.004)	.554* (.001)	.728* (.000)	.470* (.008)	.760* (.000)	1.000	
Total	.682* (.000)	.697* (.000)	.875* (.000)	.730* (.000)	.851* (.000)	.876* (.000)	1.000

Hypothesis 6. There is no significant difference in the level of customer satisfaction toward the general automotive repair shops due to customers' genders, ages, education levels, and annual family income.

This hypothesis examined whether customers' genders, ages, education levels, and annual family income affect the level of customer satisfaction toward the general automotive repair shops. Three analyses of variance (ANOVA) and a linear regression analysis were conducted to test the hypothesis. The dependent variable was the mean score of the CSAI. The independent variables were the customer's gender, age, education level, and annual family income.

None of the test results attains significance by setting α equal to .05 (Table 4.23). We may say that the customers' genders, ages, education levels, and annual family income do not affect the level of customer satisfaction toward the general automotive repair shops.

Table 4.23 Analyses of variance (ANOVA) and linear regression of customer satisfaction related to customer's gender, age, education level, and annual family income

	S. V.	S. S.	D. F.	M. S.	F	Sig. of F
Gender	Between Groups	.0023	1	.0023	.011	.919
	Within Groups	23.078	105	.220		
	Total	23.090	106			
Age	Regression	.096	1	.096	.456	.501
	Residual	21.773	103	.211		
	Total	21.870	104			
Education level	Between Groups	1.156	3	.385	1.849	.143
	Within Groups	20.633	99	.208		
	Total	21.789	102			
Annual family income	Between Groups	2.159	7	.308	1.475	.186
	Within Groups	19.655	94	.209		
	Total	21.815	101			

Hypothesis 7. There is no significant difference in the level of customer satisfaction due to the cost of the automotive repair service.

This hypothesis examined the relationship between the level of customer satisfaction and the cost of the automotive repair service. A linear regression analysis was conducted to test the hypothesis. The dependent variable was the mean score of the CSAI. The independent variable was the cost of automotive repair service.

In Table 4.24, the test result attains significance ($p \leq .014$). The R-square value equals .058 and the adjusted R-square value equals .049 (Table 4.25). Moreover, the scatter plot of the dependent variable by the standardized residuals appears to follow a linear pattern. This indicates that there might be a relationship between the two tested variables (Figure 4.17).

In Figure 4.18 the Q-Q plot of the standardized residuals seems to follow a straight-line appearance. This might indicate that the normality assumption is held. In Figure 4.19, the variability of the studentized deleted (press) residuals keeps stable with the increasing standardized predicted values. This might indicate that the constant variance assumption for this linear regression model is held. In Table 4.25, however, the Durbin-Watson statistic value

Table 4.24 Linear regression of customer satisfaction and the cost of repair service

S. V.	S. S.	D.F.	M S.	t	F	Sig. of F
Regression	1.287	1	1.287	-2.503	6.266	.014*
Residual	20.957	102	.205			
Total	22.244	103				

* significant at .05.

Table 4.25 R-square, adjusted R-square, and Durbin-Watson values in the linear regression of customer satisfaction and the cost of repair service

Model					
Dependent Variable	Independent Variable	R	R-Square	Adjusted R-Square	Durbin-Watson
Customer satisfaction	Cost of automotive repair service	.241	.058	.049	1.027

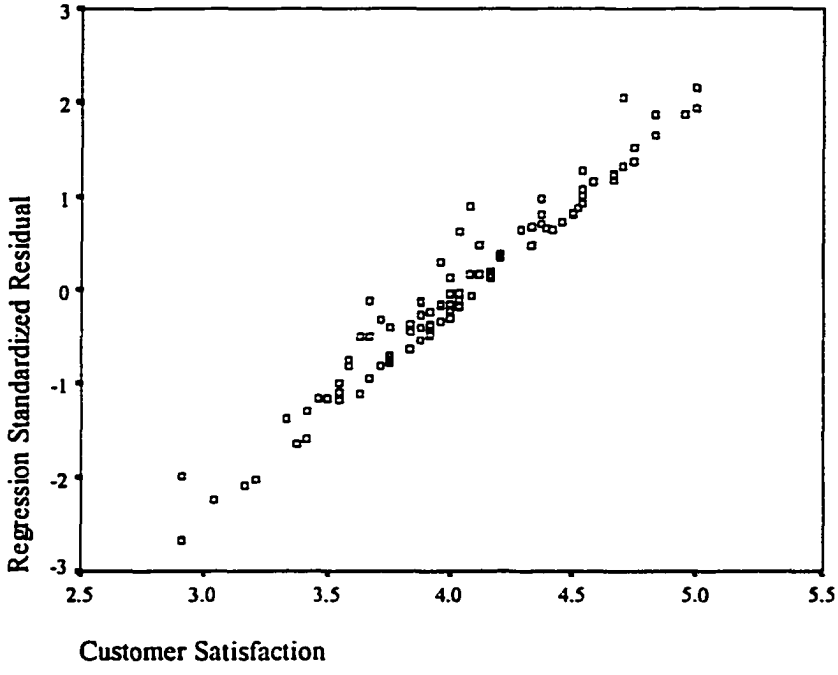


Figure 4.17 The scatter plot of customer satisfaction and the cost of repair service

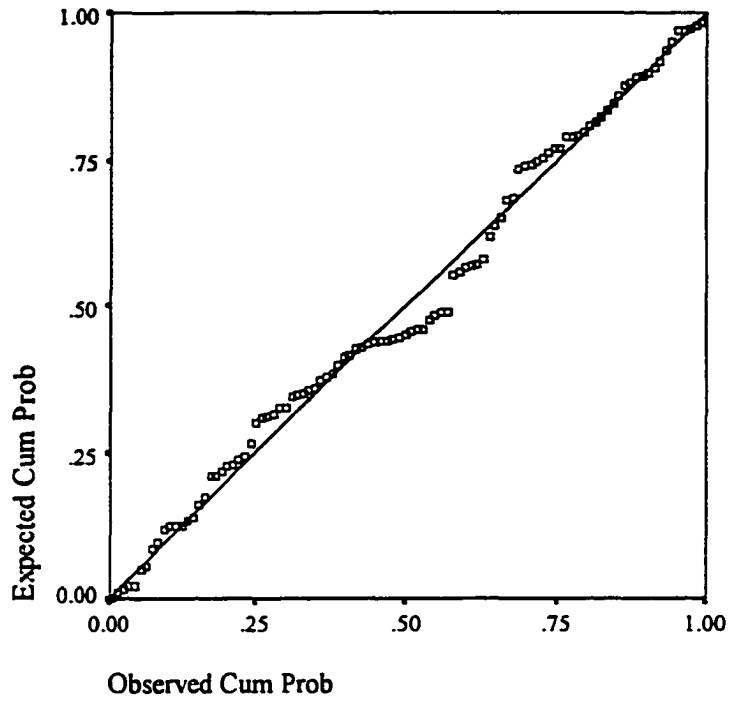


Figure 4.18 The Q-Q plot of customer satisfaction and the cost of repair service

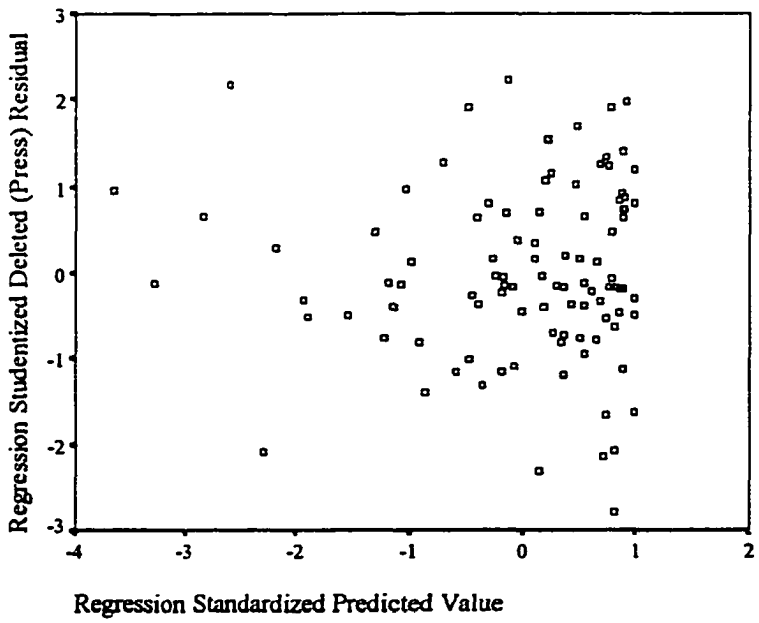


Figure 4.19 The studentized residuals plot of customer satisfaction and the cost of repair service

equals 1.027. The independent assumption is violated by testing the Durbin-Watson statistic value. The violation of the independence assumption might be derived from the repeated measurement of the CSAI in the same general automotive repair shop.

In conclusion, the test result violates the assumption of independence. However, from the scatter plot of customer satisfaction by the standardized residuals (Figure 4.17), it appears that a linear relationship exists between the dependent variable and the independent variable. Moreover, the linear regression analysis attains the level of significance with a negative slope (t-value equal to -2.503) . We may say that the null hypothesis is rejected. It seems that the higher the cost of the automotive repair service, the lower the level of satisfaction perceived by the customers.

Hypothesis 8. There is no significant difference in the level of customer satisfaction due to the ages of the repaired vehicles.

This hypothesis examined the relationship between the level of customer satisfaction and the ages of the repaired vehicles. A linear regression analysis was conducted to test the hypothesis. The dependent variable was the mean score of the CSAI. The independent variable was the age of the repair vehicle.

In Table 4.26, the test result attains significance ($p \leq .003$). The R-square value equals .080 and the adjusted R-square value equals .071 (Table 4.27). Moreover, the scatter plot of the dependent variable by the standardized residuals appears to follow a linear pattern (Figure 4.20). There might be a relationship between the two tested variables (Figure 4.20).

In Figure 4.21 the Q-Q plot of the standardized residuals seems to have a straight-line appearance. This suggests that the normality assumption is held. In Figure 4.22, the

variability of the studentized deleted (press) residuals keeps stable with the increasing standardized predicted values. This indicates that the constant variance assumption for this linear regression model is held.

In Table 4.27, however, the Durbin-Watson statistic value equals 1.043. The independence assumption is violated by testing the Durbin-Watson statistic value. The violation of the independence assumption might be derived from the repeated measurement of the CSAI in the same general automotive repair shop.

In conclusion, the test result might violate the assumption of independence. However, from the scatter plot of customer satisfaction by the standardized residuals (Figure 4.20), it appears that a linear relationship exists between the dependent variable and the independent variable. Moreover, the linear regression analysis attains significance with a negative slope (t-value equal to -3.020) . We may say that the null hypothesis is rejected. It seems that the customers who owned older vehicles perceived a lower level of customer satisfaction in the general automotive repair shops.

Table 4.26 Linear regression of customer satisfaction and the ages of serviced vehicles

S. V.	S. S.	D.F.	M. S.	t	F	Sig. of F
Regression	1.846	1	1.846	-3.020	9.123	.003*
Residual	21.244	105	.202			
Total	23.090	106				

* significant at .05.

Table 4.27 R-square, adjusted R-square, and Durbin-Watson values in the linear regression of customer satisfaction and the ages of serviced vehicles

Model					
Dependent Variable	Independent Variable	R	R-Square	Adjusted R-Square	Durbin-Watson
Customer satisfaction	Age of repaired vehicle	.283	.080	.071	1.043

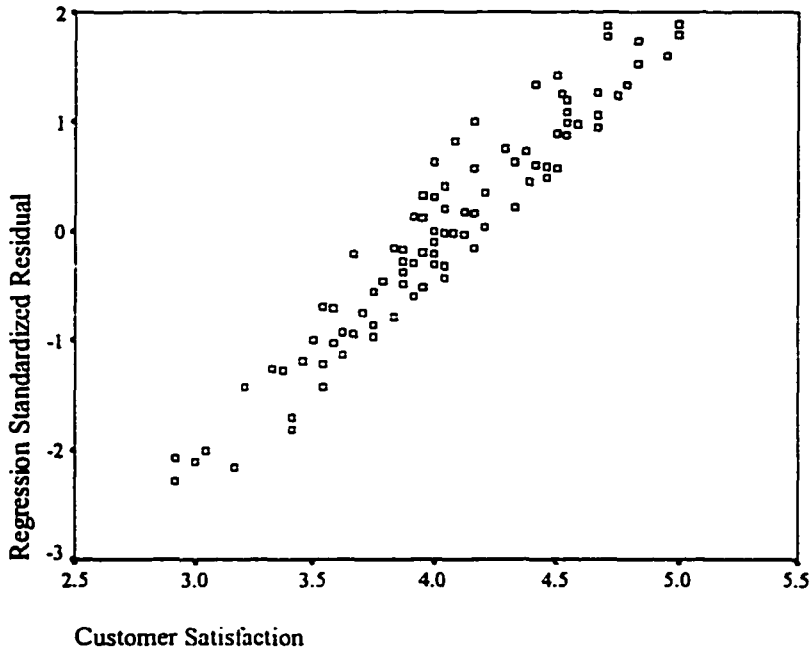


Figure 4.20 The scatter plot of customer satisfaction and the ages of serviced vehicles

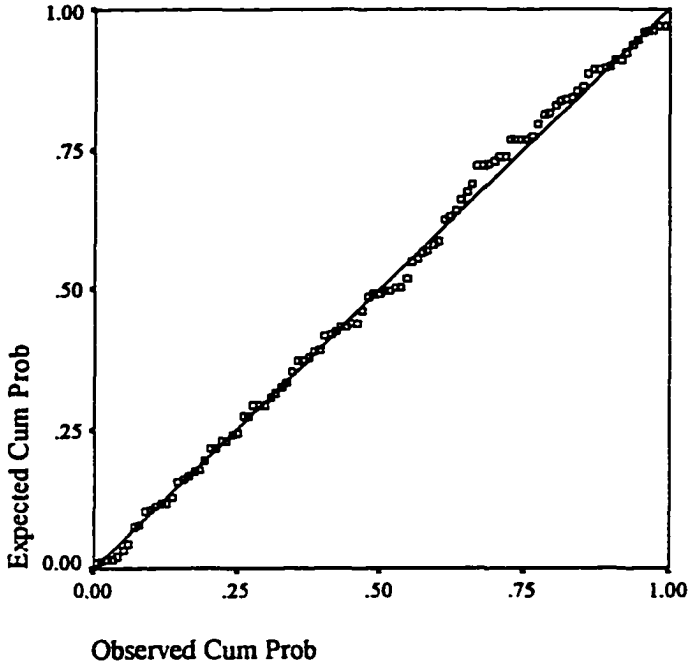


Figure 4.21 The Q-Q plot of customer satisfaction and the ages of serviced vehicles

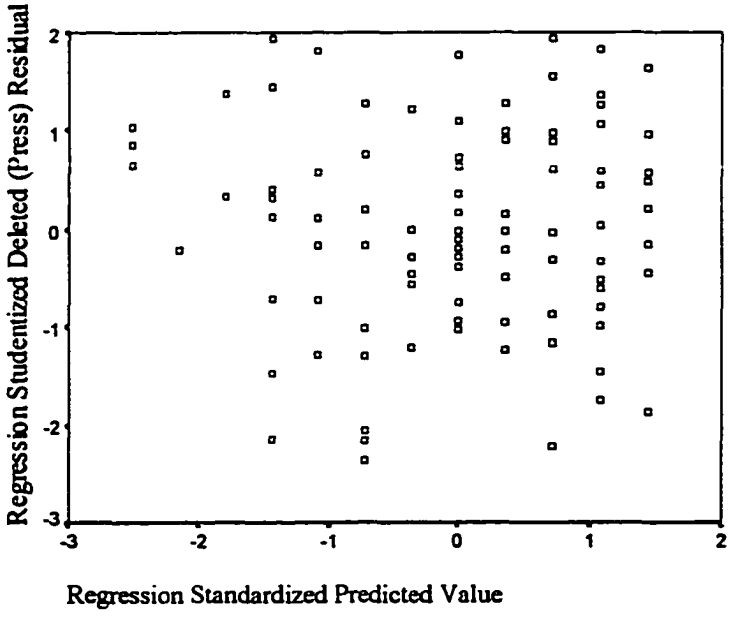


Figure 4.22 The studentized residuals plot of customer satisfaction and the ages of serviced vehicles

Hypothesis 9. There is no significant difference in the level of customer satisfaction among different sizes of general automotive repair shops.

This hypothesis examined whether the number of full-time employees affects the level of customer satisfaction in the general automotive repair shops. A linear regression analysis was conducted to test the hypothesis. The dependent variable was the mean score of the CSAI. The independent variable was the number of full-time employees of the general automotive repair shops.

In Table 4.28, the test result attains significance ($p \leq .000$). The R-square value equals .144 and the adjusted-R square value equals .136 (Table 4.29). Moreover, the scatter plot of the dependent variable by the standardized residuals appears to follow a linear pattern (Figure 4.23). This indicates that there might be a relationship between the number of full time employees and the level of customer satisfaction in the general automotive repair shops.

In Figure 4.24, the Q-Q plot of the standardized residuals seems to have a straight-line appearance. This indicates that the normality assumption is held. In Figure 4.25, the variability of the studentized deleted (press) residuals approximately keeps stable with the increasing standardized predicted values. This suggests that the constant variance assumption for this linear regression model is not violated. In Table 4.29 the Durbin-Watson statistic value equals 1.186. The independence assumption is violated by testing the Durbin-Watson statistic value. The violation of the independence assumption might be derived from the repeated measurement of the CSAI in the same general automotive repair shop.

In conclusion, the test result might violate the assumption of independence. However, from the scatter plot of customer satisfaction by the standardized residuals (Figure 4.23), it appears that a linear relationship exists between the dependent variable and the independent

variable. Moreover, the linear regression analysis attains significance, with a positive slope (t-value equal to 4.210). We may say that the null hypothesis is rejected. It seems that the larger the number of full-time employees at the general automotive repair shop, the higher the level of satisfaction perceived by the customer.

Table 4.28 Linear regression of customer satisfaction and the number of full-time employees

S. V.	S. S.	D. F.	M. S.	t	F	Sig. of F
Regression	3.334	1	3.334	4.210	17.720	.000*
Residual	19.755	105	.188			
Total	23.090	106				

* significant at .05.

Table 4.29 R-square, adjusted R-square, and Durbin-Watson values in the linear regression of customer satisfaction and the number of full-time employees

Model					
Dependent Variable	Independent Variable	R	R-Square	Adjusted R-Square	Durbin-Watson
Customer satisfaction	Number of full-time employees	.380	.144	.136	1.186

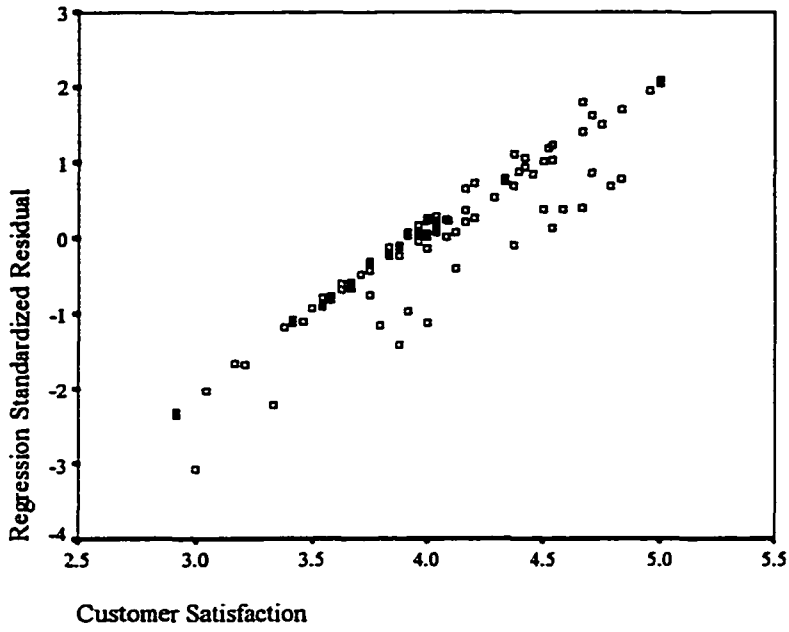


Figure 4.23 The scatter plot of customer satisfaction and the number of full-time employees

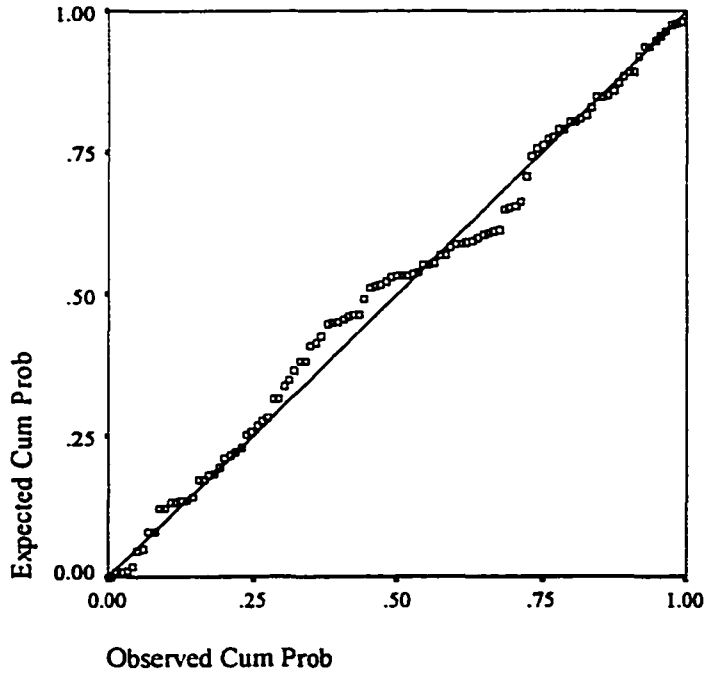


Figure 4.24 The Q-Q plot of customer satisfaction and the number of full-time employees

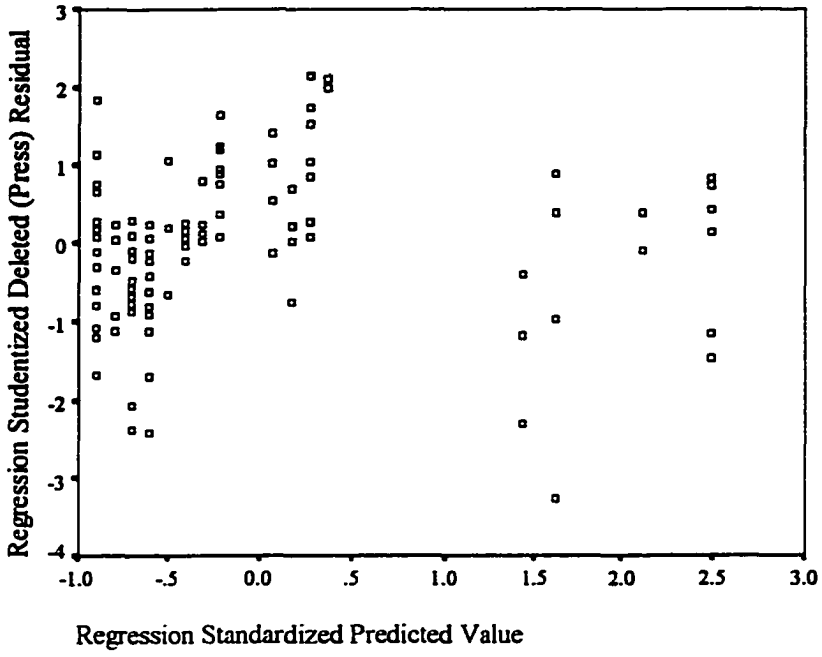


Figure 4.25 The studentized residuals plot of customer satisfaction and the number of full-time employees

A correlation analysis was conducted to investigate the relationship between the variables in the CSAI. The result of the analysis is summarized in Table 30. The customers' ages had a positive relationship with the level of empathy regarding their automotive repair experience. The customers' education level had a positive relationship with their annual family income and the level of convenience. The cost of repair service had a positive relationship with the age of serviced vehicles, and it negatively affected the level of empathy, responsiveness, reliability, and the overall customer satisfaction toward customers' automotive repair experience. The age of serviced vehicles also negatively influenced the level of fairness, responsiveness, reliability, and the overall customer satisfaction toward the general automotive repair shops.

Table 4.30 Correlation matrix of the Customer Satisfaction Assessment Instrument

	Gender	Age	Education level	Annual family income	Cost of service	Age of vehicle	Fairness	Empathy	Responsive -ness	Reliability	Convenience	Total
Gender	1.000											
Age	.074	1.000										
Education level	-.084	.065	1.000									
Annual family income	-.010	-.019	.560* (.000)	1.000								
Cost of service	.059	-.035	.055	.145	1.000							
Age of vehicle	-.116	.042	-.141	-.126	.222* (.023)	1.000						
Fairness	.027	.141	-.017	.048	-.130	-.231* (.016)	1.000					
Empathy	.019	.194* (.047)	-.106	-.036	-.267* (.006)	-.175	.568* (.000)	1.000				
Responsiveness	.001	.033	-.012	.090	-.253* (.010)	-.231* (.017)	.645* (.000)	.612* (.000)	1.000			
Reliability	-.051	-.103	-.098	-.021	-.198* (.044)	-.308* (.001)	.459* (.000)	.520* (.000)	.514* (.000)	1.000		
Convenience	-.051	-.060	-.230* (.020)	-.112	-.102	-.184	.513* (.000)	.581* (.000)	.591* (.000)	.421* (.000)	1.000	
Total	-.010	.066	-.108	.000	-.241* (.014)	-.283* (.003)	.821* (.000)	.829* (.000)	.846* (.000)	.722* (.000)	.760* (.000)	1.000

* Significant at .05.

A step-wise linear regression analysis was conducted to examine the relationship between customer satisfaction and the three independent variables (number of full-time employees, cost of repair service, and age of serviced vehicle) in the general automotive repair shops. The result presented in Appendix Q revealed that the three independent variables totally explained 24.4% of the variation on the level of satisfaction regarding customers' automotive repair experience.

Hypothesis 10. There is no significant relationship between TQM implementation and customer satisfaction regarding the five criteria in the SEVRQUAL and the seven criteria in the QMSS in the general automotive repair shops in Iowa.

This hypothesis examines the relationship between the five customer satisfaction criteria and the seven TQM implementation criteria. A multivariate analysis of variance (MANOVA) was conducted to test the hypothesis. In Table 4.31, the test result attains significance ($p \leq .000$). This indicates that the null hypothesis is rejected and there is a relationship between the five criteria in the CSAI and the seven criteria in the TQSIAI.

Table 4.31 Multivariate analysis of variance (MANOVA) of five customer satisfaction criteria with seven TQM implementation criteria

Test	Value	Exact F	Hypo. D. F.	Error D. F.	Sig. of F
Pillais	.38002	11.646	5.00	95.00	.000*
Hotellings	.61294	11.646	5.00	95.00	.000*
Wilks	.61998	11.646	5.00	95.00	.000*

* significant at .05.

A further investigation on the univariate portion of the MANOVA output (Table 4.32) shows the relationship between each criterion in the CSAI and the seven criteria in the TQSIAI. The criterion of fairness in the CSAI has a positive relationship with the criteria of customer satisfaction ($p \leq .002$) and training ($p \leq .009$), and has a negative relationship with the criterion of accountability ($p \leq .016$) in the TQSIAI. Empathy has a positive relationship with customer satisfaction ($p \leq .000$). Responsiveness has a positive relationship with customer satisfaction ($p \leq .012$), empowerment ($p \leq .014$), and training ($p \leq .000$), and has a negative relationship with accountability ($p \leq .010$). Reliability has a positive relationship with training ($p \leq .019$). The criterion of convenience has a positive relationship with the criteria of customer satisfaction ($p \leq .041$) and training ($p \leq .012$), and has a negative relationship with the criterion of accountability ($p \leq .024$).

From the previous discussion, one could see that the execution of customer satisfaction, training, and empowerment policies in the general automotive repair shops seems to increase the level of customer satisfaction regarding the five criteria in the CSAI. However, the certain accountability policies appears to have a negative influence on the level of customer satisfaction.

Hypothesis 11. There is no significant relationship between the level of TQM implementation and customer satisfaction in the general automotive repair shops in Iowa.

This hypothesis examines whether the level of TQM implementation affects the level of customer satisfaction in the general automotive repair shops. A linear regression analysis was conducted to test the hypothesis. The dependent variable is the mean score of the CSAI. The independent variable is the mean score of TQSIAI .

Table 4.32 Univariate of multivariate analysis of variance (MANOVA) of five customer satisfaction criteria with seven TQM implementation criteria

Criterion	Covariate	t	Sig. of t
Fairness	Leadership	-0.680	.498
	Customer satisfaction	**3.216**	**.002***
	Empowerment	1.241	.217
	Continuous improvement	-0.628	.532
	Accountability	**-2.446**	**.016***
	Communication	-0.092	.927
	Training	**2.674**	**.009***
Empathy	Leadership	.340	.735
	Customer satisfaction	**3.883**	**.000***
	Empowerment	1.643	.103
	Continuous improvement	-0.871	.386
	Accountability	-1.455	.149
	Communication	-0.408	.684
	Training	1.929	.057
Responsiveness	Leadership	-0.753	.453
	Customer satisfaction	**2.574**	**.012***
	Empowerment	**2.495**	**.014***
	Continuous improvement	-1.516	.133
	Accountability	**-2.620**	**.010***
	Communication	-0.680	.498
	Training	**4.452**	**.000***
Reliability	Leadership	-1.283	.202
	Customer satisfaction	.476	.635
	Empowerment	-0.772	.442
	Continuous improvement	-0.516	.607
	Accountability	-0.423	.674
	Communication	1.732	.086
	Training	**2.377**	**.019***
Convenience	Leadership	.316	.753
	Customer satisfaction	**2.071**	**.041***
	Empowerment	1.885	.062
	Continuous improvement	-0.064	.949
	Accountability	**-2.300**	**.024***
	Communication	.642	.522
	Training	**2.546**	**.012***

* Significant at .05.

In Table 4.33, the test result attains significance ($p \leq .000$). The R-square value equals .289 and the adjusted R-square value equals .283 (Table 4.34). Moreover, the scatter plot of the dependent variable by the standardized residuals appears to follow a linear pattern. This indicates that there might be a relationship between the two tested variables (Figure 4.26). In Figure 4.27 the Q-Q plot of the standardized residuals seems to follow a straight-line pattern. It might indicate that the normality assumption is held. In Figure 4.28, the variability of the studentized deleted (press) residuals does not change with the increasing standardized

Table 4.33 Linear regression of customer satisfaction and TQM implementation

S. V.	S. S.	D. F.	M. S.	t	F	Sig. of F
Regression	6.683	1	6.683	6.540	42.768	000*
Residual	16.407	105	.156			
Total	23.090	106				

* significant at .05.

Table 4.34 R-square, adjusted R-square, and Durbin-Watson values in the linear regression of customer satisfaction and TQM implementation

Model					
Dependent Variable	Independent Variable	R	R-Square	Adjusted R-Square	Durbin-Watson
Customer Satisfaction	TQM implementation	.538	.289	.283	1.240

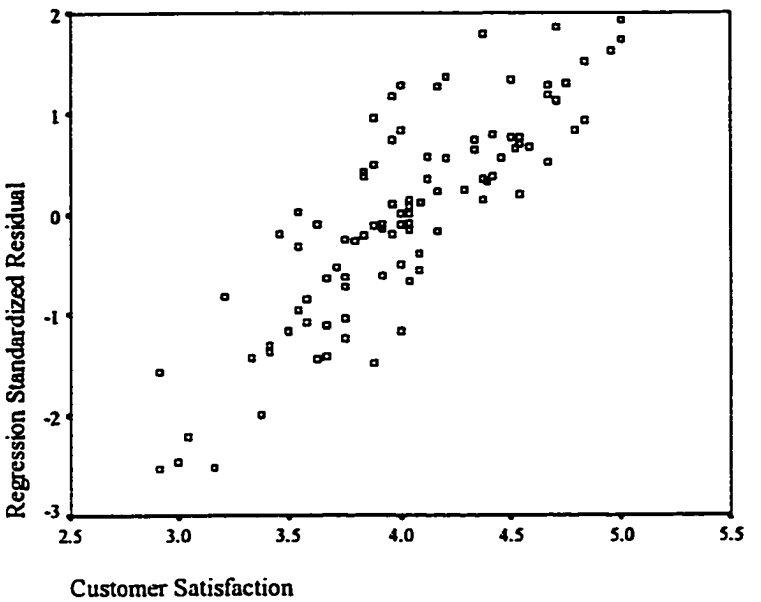


Figure 4.26 The scatter plot of customer satisfaction and TQM implementation

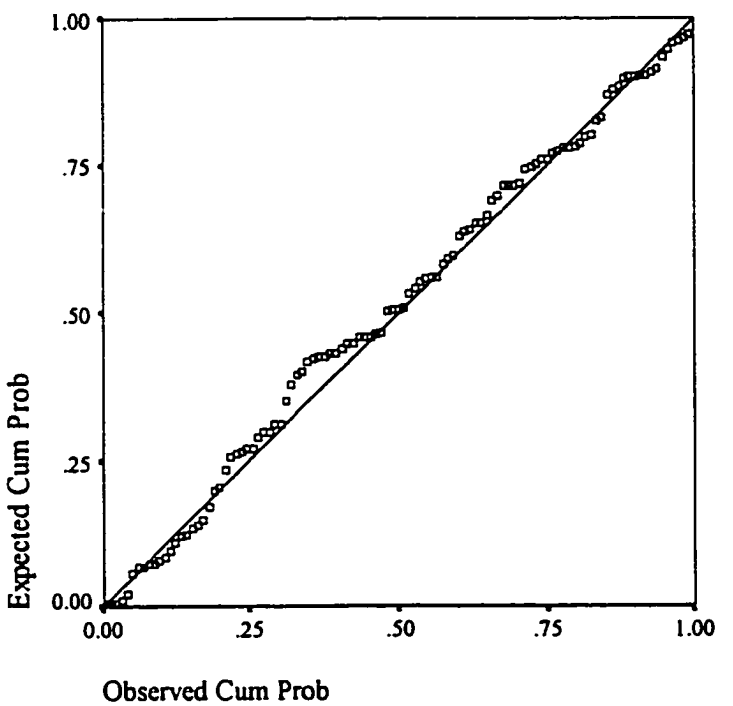


Figure 4.27 The Q-Q plot of customer satisfaction and TQM implementation

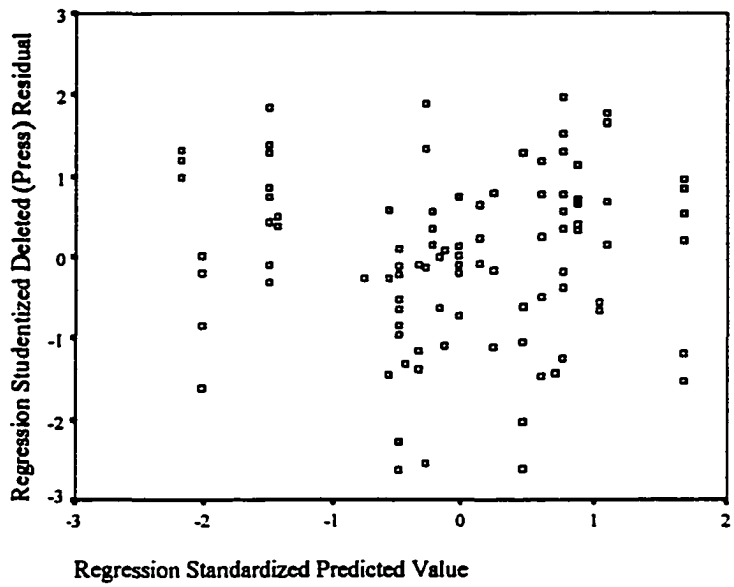


Figure 4.28 The studentized residuals plot of customer satisfaction and TQM implementation

predicted values. This might indicate that the constant variance assumption is held. However, in Table 4.34 the Durbin-Watson statistic value equals 1.240. The independent assumption is violated according to this Durbin-Watson statistic value. The violation of the independence assumption might be derived from the repeated measurement of the CSAI in the same general automotive repair shop.

The result of the linear regression analysis might violate the assumption of independence. From the scatter plot of customer satisfaction by the standardized residuals (Figure4.26), there appears to be a linear relationship between the dependent variable and the independent variable. Moreover, the linear regression analysis attains significance, with a positive slope (t-value equal to 6.540). One may say that the null hypothesis is rejected. It seems that the higher the level of TQM implementation in the general automotive repair shops, the higher the level of satisfaction as perceived by the customers.

A multivariate analysis of variance (MANOVA) was conducted to explore the relationship between the five customer satisfaction criteria and the four influential variables (number of full-time employees, cost of service, age of vehicle, and TQM implementation). In Table 4.35, the test result attains significance ($p \leq .000$). There appears a relationship between the five customer satisfaction criteria in the CSAI and the four independent variables.

A further investigation on the univariate portion of the MANOVA output (Table 4.36) shows that the criterion of fairness in the CSAI has a positive relationship with TQM implementation ($p \leq .023$). Empathy has a positive relationship with TQM implementation ($p \leq .002$), and has a negative relationship with cost of service. Responsiveness has a positive relationship with TQM implementation ($p \leq .008$), and has a negative relationship with cost of service ($p \leq .011$). Reliability has a positive relationship with TQM implementation ($p \leq .005$), and has a negative relationship with the age of vehicle. And convenience has a positive relationship with TQM implementation ($p \leq .000$). From the previous discussion, the level of TQM implementation in the general automotive repair shops seems to have the most positive influence on the level of customer satisfaction regarding the five criteria in the CSAI.

Table 4.35 Multivariate analysis of variance (MANOVA) of the five customer satisfaction criteria with the number of full-time employees, cost of repair service, ages of serviced vehicles, and TQM implementation

Test	Value	Exact F	Hypo. D. F.	D. F.	Sig. of F
Pillais	.47240	17.01	5.00	95.00	.000*
Hotellings	.89538	17.01	5.00	95.00	.000*
Wilks	.52760	17.01	5.00	95.00	.000*

* significant at .05.

Table 4.36 Univariate of multivariate analysis of variance (MANOVA) on the five customer satisfaction criteria with the number of full-time employees, cost of repair service, ages of serviced vehicles, and TQM implementation

Dep. Var.	Covariate	t	Sig. of t
Fairness	Number of full-time employees	1.817	.072
	Cost of service	-1.169	.245
	Age of vehicle	-1.077	.284
	TQM implementation	**2.312**	**.023***
Empathy	Number of full-time employees	1.207	.230
	Cost of service	**-2.737**	**.007***
	Age of vehicle	-.107	.915
	TQM implementation	**3.127**	**.002***
Responsiveness	Number of full-time employees	2.038	.044
	Cost of service	**-2.604**	**.011***
	Age of vehicle	-1.027	.307
	TQM implementation	**2.685**	**.008***
Reliability	Number of full-time employees	.589	.557
	Cost of service	--1.427	.157
	Age of vehicle	**-2.289**	**.024***
	TQM implementation	**2.885**	**.005***
Convenience	Number of full-time employees	.893	.374
	Cost of service	-.755	.452
	Age of vehicle	-.468	.641
	TQM implementation	**3.603**	**.000***

* significant at .05.

Reasons for Incomplete or Missing Response

The purpose of this section is to discuss the low response rate on the surveys in this research. The researcher received a total of twenty-six messages including letters, e-mails, and phone calls from various general automotive repair shop service managers about the reasons for incomplete or missing responses. Table 4.37 lists the reasons for incomplete or missing responses.

The major reason for incomplete or missing responses was that the service managers were too busy to participate in the survey. Twelve of the 26 service managers expressed this same concern. One service manager wrote: "I have received your questionnaires in the letter dated November 12, 1997. Problem is I am the owner, the employee, the custodian etc. I just don't have time to complete these forms. I am sorry about not participating." Another manager replied that: "I have received your request for my company to participate in your study. I do not have the staff or the time to do this properly. I am running under staffed at this time."

Table 4.37 The reasons of incomplete or missing responses

Reason	Frequency
Too busy to participate	12
Out of business	4
Manager recently retired	3
Too complicated questionnaire	3
Others	4
Total	26

Four service managers reported that their general automotive repair shops went out of business recently. One service manager sent a brief message that said: "Out of business. Please remove from list." Another manager said: "We did not do anything with the questionnaires, as we are in the process of selling the business. It will be under new ownership next year."

Two service managers stated that 10 copies of the customer satisfaction questionnaire were too many and one service manager replied that the systems of delivery of the survey were too complicated. One service manager complained to the researcher by the telephone that: "Ten copies of the customer satisfaction survey are too many for my small-sized repair shop." Another service manager returned the whole survey kits and wrote that: "I am confused by the three different colored questionnaires. Why is your survey so complicated?"

Another three auto repair shops replied that their service managers retired recently. One auto repair shop wrote back that: "I did discard the questionnaires. The service manager is retired."

Other reasons for incomplete responses included service managers' personal incidents or attitude. One service manager replied that: "One man operation. Closed at present time because of surgery." Another repair shop returned the follow-up letter and wrote that their service manager passed away recently. Regarding attitude, one service manager wrote: "Thanks for working on this. I hate all the bad press our industry gets. And it shows up in the way customers react to us about being rip off artists. The rip off are the too high salaries for CEO's and their high management."

Summary

This chapter presented the results of data analyses of the study. First the characteristics of service managers and customers in the general automotive repair shops were revealed. The mean, median, and standard deviation of each item, criterion, and the overall TQSIAI were showed. The mean of the overall TQSIAI was 3.84. The Cronbach alpha reliability coefficients of the seven criteria in the TQSIAI ranged from .43 to .81. The reliability coefficient of the overall instrument was .92.

The mean, median, and standard deviation of each item, criterion, and the overall CSAI were also presented. The mean of the overall CSAI was 4.04. The Cronbach alpha reliability coefficients of the five criteria in the CSAI ranged from .67 to .85. The reliability coefficient of the overall instrument was .92. The results of a factor analysis of each criterion and the overall instrument indicate a high level of construct validity for CSAI.

An analysis of variance (ANOVA), linear regression analysis, and multivariate analysis of variance (MANOVA) were utilized to test the eleven hypotheses in this study. In the hypothesis testing, three hypotheses were retained while eight were rejected. The results of the hypothesis testing indicate that the service managers' ages, education levels, and association memberships do not affect the level of TQM implementation in their general automotive repair shops. However, the total hours of service managers' quality management training and the number of full-time employees had positive effects on the level of TQM implementation, while the years of service managers' managerial experience had a negative influence on the level of TQM implementation in Iowa general automotive repair shops.

The results of the hypothesis testing indicate that gender, age, education level, and annual family income do not affect the level of customer satisfaction regarding their automotive repair experience. However, the cost of automotive service and the age of the repaired vehicle had a negative relationship with the level of customer satisfaction, while the number of full-time employees in the general automotive shops had a positive influence on the level of customer satisfaction regarding their automotive repair experience.

A positive relationship exists between the seven criteria in the TQSIAI and the five criteria in the CSAI. The level of the TQM implementation appears to be the most influential variable on the level of customer satisfaction in Iowa general automotive repair shops.

CHAPTER V. SUMMARY, DISCUSSIONS, CONCLUSIONS, AND RECOMMENDATIONS

Within the previous chapters, the problem of the study, and its purposes, hypotheses, literature review, methodology, and data analysis were presented. This chapter presents a summary of the preceding chapters and provides conclusions and recommendations.

Summary

The purpose of this study was to identify the relationship between the level of TQM implementation and the level of customer satisfaction in general automotive repair shops in Iowa. Benchmarking practices were employed as a tool in conducting this research. The findings of this study provide strategies for the general automotive repair shops to increase service quality and customer satisfaction.

Specifically, this research attempted to answer the following questions:

1. What is the difference in the level of TQM implementation regarding the different backgrounds of general automotive repair shop service managers in Iowa?
2. What is the difference in the level of customer satisfaction toward the automotive repair service as perceived by customers with different backgrounds?
3. Is there a relationship between TQM implementation and customer satisfaction in general automotive repair shops in Iowa?

Based on the research questions, 11 null hypotheses were formulated, and two instruments were developed and utilized for data collection. A Total Quality System Implementation Assessment Instrument (TQSIAI) which contained 35 Likert-type scaled items was developed to determine the level of TQM implementation in Iowa general

automotive repair shops. The seven criteria in the TQSIAI were based on the seven principles enumerated in the Quality Management Scoping Study (U. S. General Accounting Office, 1990b). A Customer Satisfaction Assessment Instrument (CSAI) containing 25 items on a Likert-type scale was developed to measure the level of customer satisfaction toward the general automotive repair shops. The five criteria in the CSAI were based on the five constructs that comprise the SERVQUAL (Andaleeb & basu, 1994). The contents of the instruments were validated by a panel of experts and pilot-tested at six general automotive repair shops in the Ames area.

The population of this study consisted of 834 general automotive repair shop service managers and their customers. The entire 834 service managers were asked to respond to the TQSIAI. Ten randomly chosen customers from each of the 834 general automotive repair shops were asked to respond to the CSAI. A total of 31 usable TQSIAI and 107 usable CSAI were returned and coded.

After the data collection, the reliability analyses on the TQSIAI and the CSAI were conducted. The Cronbach alpha reliability coefficients for the TQSIAI and the CSAI were both approximately .92. A principal components factor analysis with varimax rotation on the CSAI yielded seven factors. A factor analysis of the items from each criterion indicated that the items from the same criterion loaded on a single factor. These provided strong evidence of the construct validity of the CSAI.

Linear regression analysis, analysis of variance (ANOVA), and multivariate analysis of variance (MANOVA) were used in testing the 11 hypotheses in this study. By setting the value of type I error (α) equal to .05, three null hypotheses were retained while eight were

rejected. Reasons for incomplete or missing responses included: 1) the service managers were too busy to participate in the survey; 2) some automotive repair shops had gone out of business; 3) some service managers recently retired; 4) instrument delivery systems were too complicated; and 5) there were too many copies of the customer questionnaire for an automotive repair shop.

Discussions

Research question 1. What is the difference in the level of TQM implementation regarding the different backgrounds of general automotive repair shop service managers in Iowa?

The purpose of this research question was to determine whether service managers' ages, education levels, managerial experience, association membership, and quality management training were related to the level of TQM implementation in the general automotive repair shops. The relationship between the level of TQM implementation and the number of full-time employees in the general automotive repair shops was explored as well.

The TQSIAI was developed to measure the level of TQM implementation in the general automotive repair shops in Iowa. Thirty-one male general automotive repair shop service managers responded to the TQSIAI. The responding service managers' mean age was 45.3 years, and the average managerial experience was about 11 years. Most service managers reported having a two-year college degree (38.7%), closely followed by those with high school education or below (35.5%). More than two-thirds (67.7%) of the service managers reported membership in automotive or quality associations.

The mean number of full-time employees of the responding general automotive repair shops was about 8.5. However, 78.5% of the general automotive repair shops had one to

four employees. About 95% of the responding general automotive repair shops had fewer than nine employees.

A linear regression analysis was conducted of the relationship between the service managers' total hours of quality management training and the number of full-time employees. The result suggested that service managers in larger general automotive repair shops participated more in quality management training. The mean service managers' quality management training was about 37.5 hours. In the literature review, the Baldrige Award criteria suggested that employees should take 40 to 80 hours of training per year (Easton, 1993). This standard is far beyond the current training practices in Iowa general automotive repair shops.

Five hypotheses (hypotheses 1 to 5) related to research question 1 are listed below:

1. There is no significant difference in the level of TQM implementation among the general automotive repair shops due to service managers' ages and education levels.
2. There is no significant difference in the level of TQM implementation among the general automotive repair shops due to the years of service managers' managerial experience.
3. There is no significant difference in the level of TQM implementation among the general automotive repair shops due to the total hours of service managers' quality management training.
4. There is no significant difference in the level of TQM implementation among the general automotive repair shops due to service managers' association membership.

5. There is no significant difference in the level of TQM implementation among different sizes of general automotive repair shops.

The results of the hypothesis testing indicated that service managers' ages, education levels, and association membership had no relationship with the level of TQM implementation in general automotive repair shops. However, service managers' quality management training and the number of full-time employees had a positive relationship with the level of TQM implementation. Service managers' managerial experience had negative correlation with the level of TQM implementation in general automotive repair shops.

Figure 5.1 provided an empirical model of the relationship between the service managers' backgrounds and the level of TQM implementation in Iowa general automotive repair shops. In the model, the number of full-time employees, service managers' managerial experience, and service managers' quality management training respectively explained 18.7%, 18.1%, and 22.6% of the variation in the level of TQM implementation in general automotive repair shops.

A step-wise linear regression analysis (Appendix P) indicated that service managers' managerial experience and quality management training together explained 40.6% of the variation on the level of TQM implementation in the general automotive repair shops. However, the number of full-time employees was eliminated in this regression model.

In previous discussion, the number of full-time employees was related to the service managers' quality management training. Therefore, service managers' managerial experience with quality management training became the most influential factor affecting TQM implementation in general automotive repair shops. Younger (1993) wrote that: "One of the

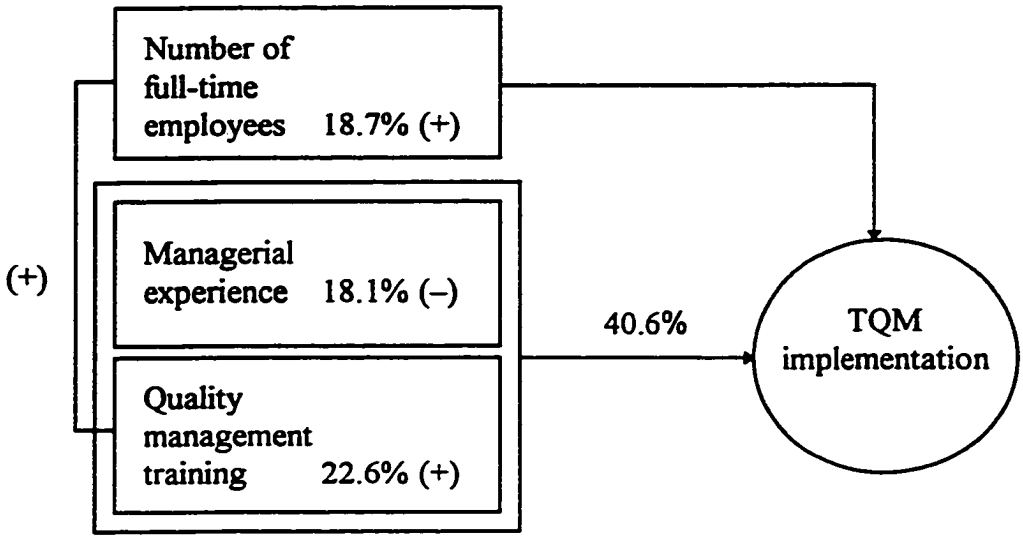


Figure 5.1 The empirical model of "service manager–TQM implementation" in the general automotive repair shops

biggest failings we have in American industry today is a lack of training, and almost a lack of awareness of the need for training" (p. 12). Galagan (1992) also indicated that leadership is the key in the continuous quality improvement processes in an organization. The most critical step for an organization to initiate training is to train the managers and supervisors thoroughly. In Crandall's (1994) research, manager training and total quality management as performance management practices will be the most important issues in the organization in the future. Younger (1993) presented a similar idea that any company could not reach its potential until it starts training. Therefore, the establishment of training policy might be the first step for adopting TQM in general automotive repair shops.

The insufficient training for managers in general automotive repair shops may be related to the facts that they have few employees and limited budgets. Most small company managers complain that formal training is too costly for them (Mangelsdorf, 1993). In small

service companies with few employees, there are few business policies, procedures, and documents to follow and the performances often rely on the individual contributor's knowledge and experience (Price & Chen, 1993). Therefore, big companies have training programs, while small companies hire trained workers or employees learn on the jobs (Mangelsdorf, 1993).

However, when the training budget is lean in a small firm, there are still many choices for training. Galagan (1992) suggested three options for small firms to initiate training:

1. Hire small or midsize consulting firms.
2. Buy off-the-shelf training programs.
3. Form partnerships with local education institutions.

Mangelsdorf (1993) provided answers to some common questions on how to set up training in a small company (Table 5.1). The training initiation strategies used in small firms might be applied in general automotive repair shops.

Another influential variable was the service managers' managerial experience. The analyses revealed that the longer the service managers' managerial experience, the lower the TQM implementation in general automotive repair shops. Not much literature, however, was found about this issue. Further investigation may be necessary to determine how service managers' managerial experience influences TQM implementation in the service industries.

In conclusion, the service managers' ages, education levels, and association membership were not related to the level of TQM implementation in general automotive repair shops. The service managers' quality management training and the number of full-time employees had a positive relationship with the level of TQM implementation, while the service

managers' managerial experience had a negative relationship with the level of TQM implementation in general automotive repair shops. The service managers' managerial experience and quality management training together explained 40.6% of the variation in the level of TQM implementation in the general automotive repair shops. The initiation of training programs for the manager and the employees might be the first step for a general automotive repair shop to adopt TQM.

Table 5.1 The questions and answers on how to establish training in a small company

Question	Answer
1. My business does not have the time or money for a conventional in-house training program. How else can I train?	• Formalize the "buddy" system. • Use books. • Try outside seminars and classes. • Have employees give presentations. • Join forces with other companies. • Build a career track.
2. I want to start an in-house training program, but I am a businessperson, not an educator. What should the classes be like?	• Keep it useful; if you are not sure what employees want to know, ask. • Keep it hands on, active, and lively. • Make general ideas practical by using examples from your company. • Give on job assignments and tests.
3. How do I make sure employees take the training seriously?	• Do it yourself. • Celebrate accomplishments. • Use rehearsals.
4. Where can I find course material–or someone to design a course?	• Big company you work with. • Trade associations. • In-house expertise.
5. Is there any outside assistance available for in-house training?	• Community colleges and other local institutions. • State programs. • Federal programs.
6. Now I have got a lot of information. But I still do not know one crucial thing: where am I supposed to start?	• As a small business person, you are pretty much on your own.

(Mangelsdorf, 1993, p. 83).

Research question 2. What is the difference in the level of customer satisfaction toward automotive repair service as perceived by customers with different backgrounds?

The purpose of this research question was to determine whether the customers' gender, age, education level, or annual family income were related to the level of customer satisfaction toward general automotive repair shops in Iowa. The relationships between the level of customer satisfaction and the cost of repaired service, ages of serviced vehicles, and the number of full-time employees in the general automotive repair shops were explored as well.

The CSAI was developed to measure the level of customer satisfaction toward general automotive repair shops. The total number of customers responding to the CSAI was 107 in which 36 (33.6%) were female and 71 (66.4%) were male. The mean age of the customers was 45.6 years. Most customers reported having a high school diploma (44.7%) or a four-year college degree (18.4%). Twenty-one (19.6%) customers had an annual family income between $30,001 and $40,000, 20 customers (18.7%) between $40,001 and $50,000, and 18 customers (16.8%) between $50,001 and $60,000.

A linear regression analysis was conducted of the relationship between the cost of repaired service and the ages of serviced vehicles. The result suggested that the older the vehicle, the higher the repair cost. The mean cost of the service was about $250, with a standard deviation of $390.31. The mean age of the serviced vehicles was 5.2 years.

Four hypotheses (hypotheses 6 to 9) related to research question 2 are listed below:

6. There is no significant difference in the level of customer satisfaction toward the general automotive repair shops due to customers' genders, ages, education levels, and annual family income.

7. There is no significant difference in the level of customer satisfaction due to the cost of the automotive repair service.
8. There is no significant difference in the level of customer satisfaction due to the ages of the repaired vehicles.
9. There is no significant difference in the level of customer satisfaction among different sizes of general automotive repair shops.

The results of hypotheses tests indicated that customers' gender, age, education level, and annual family income were not related to the level of customer satisfaction toward general automotive repair shops. However, the cost of repair service and the ages of the serviced vehicles had a negative relationship with the level of customer satisfaction, while the number of full-time employees in general automotive repair shops had a positive relationship with the level of customer satisfaction regarding their automotive repair experience.

Figure 5.2 provides an empirical model of the relationship between the customers' backgrounds and the level of customer satisfaction toward their automotive repair experience. In the model, the number of full-time employees explained 14.4% of variation in the level of customer satisfaction. The cost of repair service and the age of the serviced vehicle respectively explained 5.8% and 8.0% of the variation on the level of customer satisfaction. A step-wise linear regression analysis (Appendix Q) indicated that all three variables (number of full-time employees, cost of repair service, and age of serviced vehicle) together explained 24.4% of the variation in the level of customer satisfaction toward general automotive repair shops.

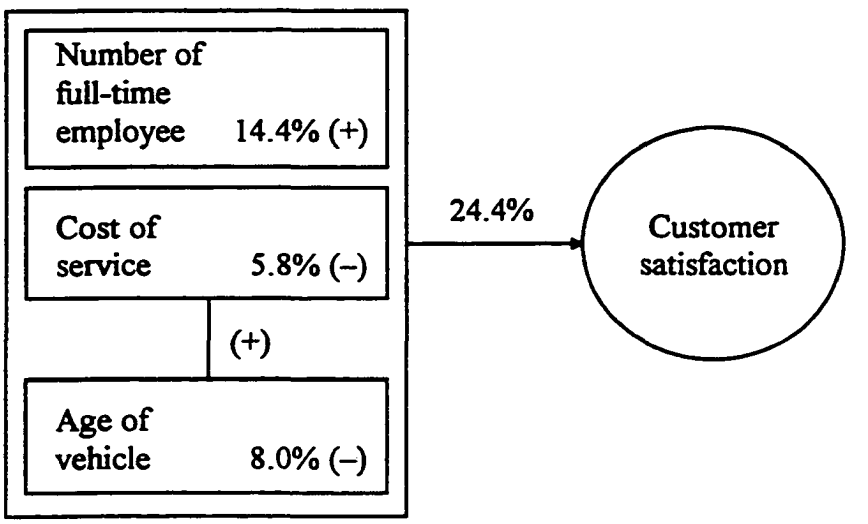


Figure 5.2 The empirical model of "customer–customer satisfaction" in the general automotive repair shops

In previous discussion, the ages of vehicles were related positively to the cost of service. The number of full-time employees had a relationship with service managers' quality management training, which was related to TQM implementation in general automotive repair shops. Besides, in Table 4.9 the criterion with the lowest mean value (3.82) on the CSAI is fairness. Specifically, items 1 and 2 on the CSAI, which measured the fairness of the price for automotive repair labor and parts, had the second and third-lowest mean value on the customer satisfaction survey. Therefore, the reasons for low customer satisfaction in the automotive repair industry appear to be low service quality and high service cost (Andaleeb & Basu, 1994). In Neckopulos's (1996) research, customer satisfaction is impacted not only by service performance but also by cost. Today's customers want both excellent service and competitive pricing.

The expensive charges for automotive repair service might be derived from the cost of poor quality or the cost of nonconformance. The cost of nonconformance is the total cost of

failure to achieve quality, including wrong diagnosis, inappropriate job order, rework, resetting, change supply orders, inventory, customer complaint, and customer permanent withdrawal, among other considerations (Saylor, 1992). The automotive repair business was recognized as one of the industries with the lowest level of customer satisfaction (Crandall, 1997). The implementation of TQM will create more efficient business processes and the executive skill to deliver lower costs and higher-quality service (Price & Chen, 1993). Appendix R lists suggestions on how to reduce the cost of nonconformance.

In conclusion, the customers' gender, age, education level, and annual family income were not related to the level of customer satisfaction toward general automotive repair shops. The cost of repair service and the age of the serviced vehicle had a negative relationship with the level of satisfaction, while the number of full-time employees had a positive relationship with the level of satisfaction regarding customers' automotive repair experience. These three independent variables combined explained 24.4% of the variation in the level of customer satisfaction toward general automotive repair shops.

Research question 3. Is there a relationship between TQM implementation and customer satisfaction in general automotive repair shops in Iowa?

The purpose of this research question was to examine whether TQM implementation in the general automotive repair shops was related to the level of customer satisfaction toward the automotive repair experience. Hypotheses 10 and 11 were related to this research question:

10. There is no significant relationship between the five customer satisfaction criteria and the seven TQM implementation criteria.

11. There is no significant relationship between the level of customer satisfaction and the level of TQM implementation in the general automotive repair shops in Iowa.

The results of the hypothesis tests indicated that the higher level of TQM implementation in the general automotive repair shops, the higher the level of satisfaction as perceived by the customer. The level of TQM implementation in general automotive repair shops explained 28.9% of the variation on the level of customer satisfaction. A further multivariate analysis of variance (MANOVA) indicated that among the four independent variables (cost of service, age of vehicle, number of full-time employees, and TQM implementation), TQM implementation was the most influential variable on the level of customer satisfaction regarding the five criteria in the CSAI (Table 5.2).

A summary of multivariate analysis of variance (MANOVA) of the relationship between the five criteria in the CSAI and the seven criteria in the TQSIAI is also displayed in Table 5.2. The execution of customer satisfaction policy in general automotive repair shops had a positive relationship with the level of customer satisfaction regarding the criteria of fairness, empathy, responsiveness, and convenience. The execution of training also had a positive relationship with fairness, responsiveness, reliability, and convenience. The execution of empowerment was positively related to responsiveness. However, the accountability policy in general automotive repair shops was negatively related to the level of customer satisfaction regarding the criteria of fairness, responsiveness, and convenience.

According to Olian and Rynes (1991), four outcome measures should be used to implement accountability in an organization: 1) customer reaction measures; 2) operation measures; 3) financial measures; and 4) employee contribution measures. Because of a lack of

operation measures, financial measures, and employee contribution measures, the TQSIAI might not be sufficient to evaluate accountability implementation in general automotive repair shops. Therefore, we cannot say that the execution of accountability policy decreased the level of customer satisfaction in general automotive repair shops.

In the previous discussion, most of the general automotive repair shops had fewer than nine employees. Because of the small number of full-time employees, there is a tension in the automotive repair shop between the long-term interest to establish the processes and the short-term desire to get repair work done immediately. Shea and Gobeli (1995) interviewed small businesses and reported that in small companies "customer feedback was only occasionally being used; employees had limited responsibility for resolving customer issues; operating procedures were not well defined; and process improvements were not being made." According to Price and Chen (1993), most of the small companies avoided TQM because: "it may stifle creativity and initiative and reduce the ability of the organization to react quickly ...but if a small, high-technology company wants to obtain a long-term viability, the adoption of TQM is essential." The early success of a small company often is established on the technological advantage or a growing market. However, as the customers' expectations increase, business needs to invest in learning how to satisfy customers (Price & Chen, 1993).

In conclusion, the level of TQM implementation had a positive relationship with the level of customer satisfaction. The execution of customer satisfaction and training policies in general automotive repair shops increased customer satisfaction significantly regarding the five customer satisfaction criteria.

Table 5.2 The relationship between the five customer satisfaction criteria and the number of full-time employees, cost of service, ages of vehicles, and TQM implementation

	Customer satisfaction				
Variables	Fairness	Empathy	Responsiveness	Reliability	Convenience
Number of full-time employees	.	.	.	.	.
Cost of service	.	−	−	.	.
Age of vehicle	.	.	.	−	.
TQM implementation	+	+	+	+	+
Leadership	.	.	.	.	.
Customer satisfaction	+	+	+	.	+
Empowerment	.	.	+	.	.
Continuous improvement	.	.	.	.	.
Accountability	−	.	−	.	−
Communication	.	.	.	.	.
Training	+	.	+	+	+

Conclusions

In this research, a conceptual research model (Figure 3.1) was developed. The model was based on the need to explore the relationship between the level of TQM implementation and customer satisfaction in general automotive repair shops. Two surveys were conducted and eleven hypotheses were tested to answer the research questions. Benchmarking processes were employed to conduct this research. The findings of this study support adopting TQM to improve the service quality and improve customer satisfaction in general automotive repair shops.

Based on the data analyses of this study, an empirical model of the relationship between TQM implementation and customer satisfaction in general automotive repair shops was suggested (Figure 5.3). In this model, service managers' demographic variables (including managerial experience and quality management training) explained 40.6% of the variation in the level of TQM implementation in general automotive repair shops. Customers' demographic variables (including cost of repair service and age of serviced vehicle) and the number of full-time employees in the general automotive repair shops explained 24.4% of the variation in the level of customer satisfaction. In addition, the level of TQM implementation explained 28.9% of the variation in the level of customer satisfaction in general automotive repair shops.

The findings demonstrated the importance of the initiation of quality management training for general automotive repair shop service managers. The discussion on how to practice training in small firms might be helpful references for general automotive repair shops when conducting training programs. The knowledge and skills a service manager should possess in the TQM environment must be included in the training programs. As soon as a service manager gains the skill to lead the TQM practices, all employees in the company also should be trained to ascertain a company-wide accomplishment. In order to deliver the training, service managers may consider the specific infrastructure of the general automotive repair shops to assure that the training program is available for all employees. Besides, the incentives for the employees who participated in training should be emphasized. Once the service managers initiate in quality training, the improvement of service quality in general automotive repair shops may be on the right track.

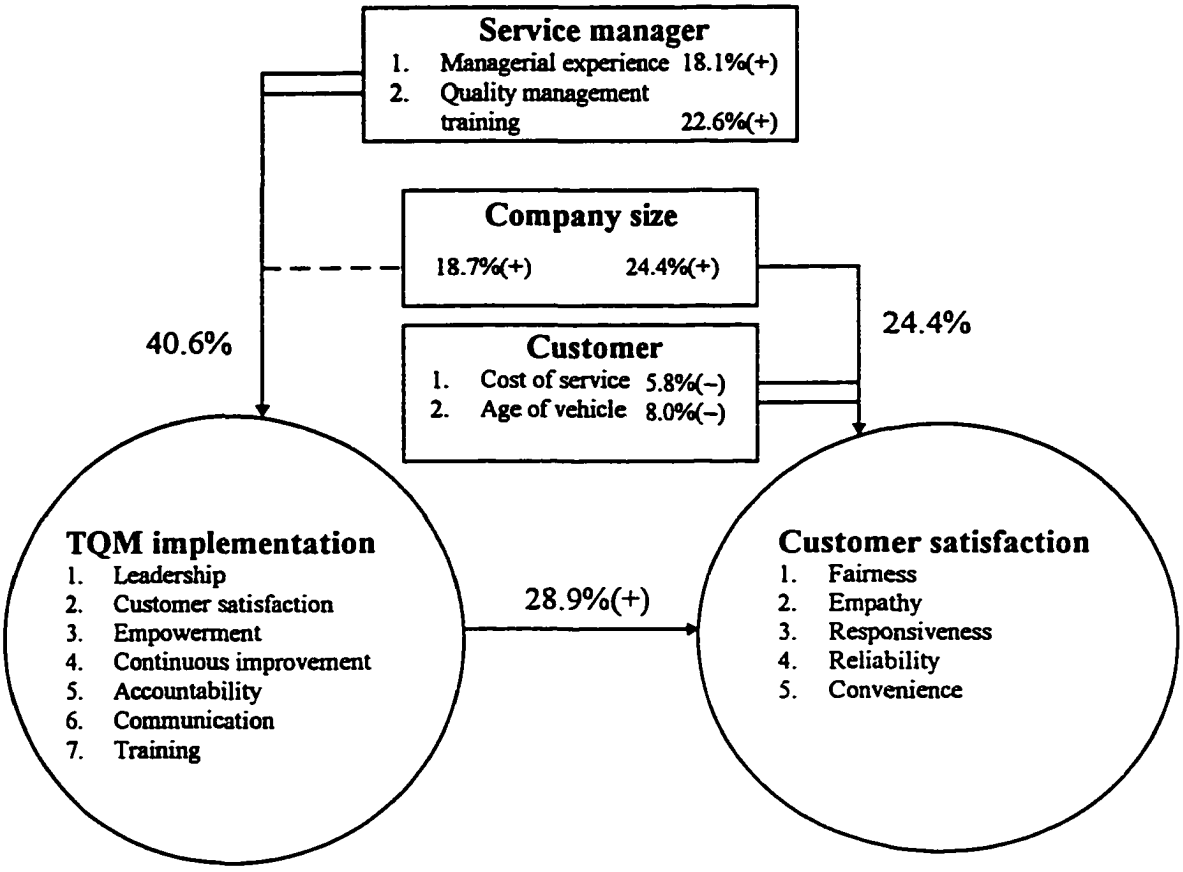


Figure 5.3 The empirical model of "TQM implementation–customer satisfaction" in the general automotive repair shops

Another implication of this study was that the increased customer satisfaction in general automotive repair shops may not come from only the improvement of service quality. Multiple findings indicated that beyond TQM implementation, other variables such as the cost of service, the ages of vehicles, and the number of full-time employees also were related to customer satisfaction. The results of the statistical analyses suggested that the variable of the number of full-time employees had a positive relationship with service managers' quality management training related to TQM implementation. There was a close relationship between the cost of service and the age of the vehicle. Therefore, cost-effectiveness became the next

attribute that had a relationship with the level of customer satisfaction in the general automotive repair shops. The high service cost in the automotive repair industry might come from the nonconformance to service quality standards. The efficiency improvement in business processes that may be expected to follow from the implementation of TQM might be the solution to reducing service cost and increasing customer satisfaction in general automotive repair shops.

In the past, many American consumers experienced low satisfaction in their contacts with the automotive repair industry. Adopting quality management systems to increase customer satisfaction may be the key to success in general automotive repair shops. The participation in quality management training by service managers had a positive relationship with TQM implementation, and was positively related to customer satisfaction. Cost-effectiveness is another relating variable affecting customer satisfaction in general automotive repair shops. Among the seven TQM implementation criteria, the execution of customer satisfaction and training policies in general automotive repair shops significantly increased customer satisfaction regarding the five criteria. In brief, the implementation of TQM to reinforce service quality, decrease service cost, and increase customer satisfaction will begin the endless process of continuous improvement for general automotive repair shops.

Recommendations

The recommendations of this study are based upon the findings and conclusions that were presented.

1. Busy service managers and a complicated questionnaire delivery system were two of the reasons for the low return rate of the surveys used in this study. Because of the

characteristics of the automotive repair industry, "on-site" interviews with the service managers and the customers in the data collection processes are suggested for future research.

2. A further examination of the construct validity of the TQSIAI is necessary. The examination could be conducted with a larger sample size to produce a more valid TQM implementation assessment instrument for the automotive repair industry.
3. A revision of the CSAI for future research is necessary. The revision could be based on the factor analysis of the CSAI in this study. The revised customer satisfaction assessment instrument might be made available to the automotive repair industry.
4. Further research on TQM implementation in the automotive repair industry might include operation measures, financial measures, and employee contribution measures in order to achieve the purpose of accountability assessment of the companies.
5. It is recommended that future research be focused on how to conduct training programs in different sizes of automotive repair shops.
6. It is recommended that future research be focused on how service managers' managerial experience influences TQM implementation in the service industries.
7. Qualitative research is recommended for future study of the highly successful automotive repair shops. The focus of the qualitative research could be on exploring the business processes of these successful automotive repair shops in order to improve service quality in the automotive repair industry.

APPENDIX A. DEMING'S 14 PRINCIPLES

DEMING'S 14 PRINCIPLES

1. Create constancy of purpose for improvement of product and services.
2. Adopt the new philosophy.
3. Cease dependence on inspection.
4. End the practice of awarding business on price tag along.
5. Improve constantly and forever the system of production and service.
6. Institute training.
7. Institute leadership.
8. Drive out fear.
9. Break down barriers between staff areas.
10. Eliminate slogans, exhortations, and targets for the workforce.
11. Eliminate numerical quotas.
12. Remove barriers to pride of workmanship.
13. Institute a vigorous program of education and retraining.
14. Take action to accomplish the transformation.

Source: Blankstein, A. M. (1992). Lessons from enlightened corporations. *Educational Leadership*, *49*(6), 71-75.

APPENDIX B. QS 9000 AUDITOR'S CHECK LIST

QS 9000 AUDITOR'S CHECK LIST

4.1 Management Responsibility

1. How do you assure that your quality policy is widely known and understood?
2. Can I see your organizational chart?
3. How do you delegate authority to manage your quality system?
4. What multi-disciplinary problem-solving method do you use?
5. How often do you review the effectiveness of the quality management system?
6. Can I see those meeting notes?
7. How do you assure qualified people are in support positions?
8. Who is responsible for QS-9000 implementation?
9. Can I see a business plan showing QS-9000 as a part of it?
10. Do you use benchmarking for quality, production, and operation efficiency?
11. Can I see the data?
12. How do you measure customer satisfaction? Is it a formal plan?
13. Do you use multi-functional teams for advanced quality planning?

4.2 Quality System

1. Show me your level II quality manual.
   *Examine the manual to assure that all document requirements of QS-9000 as own in the standard have been addressed.
2. Does the quality planning process parallel the level II manual description and level III procedures for the following:
   A. product program plan preparation
   B. resource acquisition
   C. design and process capability studies
   D. updating and maintenance of quality control and inspection methods
   E. control plan development
   F. review of standards and specifications
3. Do you conduct design feasibility reviews? Can I see the results for products x, y, and z?
4. Did this design review also encompass the statistical capabilities?
5. To what level do you develop control plans?
6. Do the control plans include all special characteristics? How do you know?
7. When do you revise a control plan?
8. Do control plans cover all three phases of production?
9. Do FMEAs consider special characteristics?

4.3 Contract Review

1. How do you define a contract?

2. Is that in writing?
3. Do you require QS-9000 of your subcontractors?
4. Can I see where you acquire compliance (how notified)?
5. How do you change customer requirements under a current contract when requested to do so by a customer?
6. How are contracts reviewed?
7. Can I see those records?

4.4 Design Control

1. How are design plans established?
2. How do you know that people assigned to a project have the necessary skills?
3. What are applicable regulation standards? How are they identified?
4. Do you use CAD/CAE? If you subcontract, how did you select the suppliers?
5. Can I see records of project/product design reviews?
6. Can those design outputs be verified?
7. Does the design output meet customers input requirements?
8. How do you cross reference?
9. Does your design output process include any of the following:
   A. GDT and other design techniques as listed in 4.4.2
   B. customer performance risk trade off analysis
   C. testing--production and field
   D. design FMEA
10. Can I see your performance testing results?
11. Can I see your prototype program results?
12. Do you validate designs as part of the quality planning process?
13. Can I see your engineering change procedure?
14. Show me how the Engineering Change Notice (ECN) accommodates customer initiated change.

4.5 Document Control

1. Show me a master list of controlled documents.
2. Show me how customer-initiated changes are controlled.
3. Can I see all your reference documents?
4. Describe your document control process to me.
5. How do you control documents resident in software?
6. What special characteristics do you use?
7. Do you have a procedure for controlling customer engineering specification?

4.6 Purchasing

1. Do your subcontractors meet the same standards you do?
2. How do you survey subcontractors?

3. Can I see those records?
4. Can I see a copy of your approved vendor list?
5. How do you unapprove a vendor?
6. How do you decide to monitor a vendor?
7. Are you developing subcontractors to the requirements of QS-9000?
8. Can you verify quality on site?
9. Can you show me purchase orders? (Use this question to evaluate "completeness" of purchasing requirements section.)

4.7 Purchaser Supplied Product

1. Do you inspect product supplied by your customer at receiving and then periodically to assure its condition?
2. Show me the procedure you use.

4.8 Product ID and Traceability

1. How do you identify product at each production stage?
2. Show me how I could take product "X" from shipping and trace it backward through the production stream.
3. Do your customers require part or component traceability?
4. Show me how you maintain traceability.

4.9 Process Control

1. How do you develop job instructions?
2. Are they complete with respect to accessibility, full communication of requirements, required tooling and gages, statistical process control, and all the requirements of 4.9.1?
3. Can we follow 3 or 4 jobs on the shop floor to assure process control?
4. Do you have a preventive maintenance and predicted maintenance plan?
5. What process do you use to ensure that all regulatory safeguards are followed? Are there certificates? Can I see them?
6. What are your process controls for items designated appearance items?

4.10 Inspection and Testing

1. How do you control purchased materials?
2. Do you require that your suppliers send you statistical data?
3. Can I see it?
4. Describe your defect prevention methods.
5. Can I follow products x, y, and z through your production process to verify your documented inspection?

6. How do you verify that product will not ship until all inspection and test procedures are complete?
7. Show me your layout and functional test records.
8. Are records maintained for production cycle plus one year?

4.11 Inspection, Measuring, Test Equipment

1. Do you use the Measurement System Analysis (MSA) manual guidelines to determine accuracy/precision?
2. Is the MSA noted on the central plan?
3. Do you use an outside calibration service?
4. Is the appropriate calibration standard noted on the proper outside service?
5. How is each piece of inspection measurement and test equipment identified?
6. How do you control or calibrate employee-acquired equipment?
7. If you drop a pair of calipers, what do you do?
8. How do you know how to use those micrometers?
9. Do you recalibrate after engineering changes?
10. How and where do you store calibration standards?
11. How can you use a gage if the calibration sticker is missing?
12. How do you identify inspection and test status throughout the production process?

4.12 Inspection and Test Status

1. How does a person on the line know the product they receive has been properly inspected or tested?
2. How do you mark the inspection and test status on your production parts?
3. May I randomly sample such parts to confirm this?
4. Are you required to have early launch controls or other identification requirements by your customer?

4.13 Control Non-conforming Product

1. Do you have segregated hold areas?
2. Do you have a Material Review Board (MRB) or related procedure?
3. Can I see the last six months MRB history?
4. What are suspect products?
5. How do you control those?
6. What do you do with non-conforming and suspect parts?
7. Do you research parts?
8. How do you trace customer approved deviations?
9. Do you record nonconformances? How?
10. Do you reinspect reworked product?
11. Show me rework and repair instructions.
12. Do you maintain records of customer approved deviations and authorized quantities?

4.14 Corrective Action

1. What problem solving method do you use?
2. Do you verify effectiveness of corrective actions?
3. What do you feel are appropriate corrective actions?
4. Do you analyze returned parts to develop corrective actions?
5. Do you use nonconformance reports to develop corrective actions?
6. Is upper management part of the review process?
7. Show me.

4.15 Handling, Storage etc.

1. Do you check or rotate stock?
2. Show me your packaging procedures.
3. Do you have customer packaging specifications? Can I see them?
4. Do you have a target of 100% on-time delivery?
5. What do you do when product is damaged in the plant?
6. Are material handling methods appropriate for the product?

4.16 Quality Records

1. Show me copies of your subcontractor development records.
2. Are records accessible on site?
3. How do you prevent deterioration of electronic records?
4. Are records retained for the following time periods at a minimum:
   a. production plus one year
   b. charts and other Level IV documents one year

4.17 Internal Quality Audits

1. Show me the last six months of internal audit reports.
2. Are corrective actions initiated from the internal audits?
3. Are auditors independent from the department/function being audited?
4. How do you schedule and prioritize audits?
5. Is upper management part of the review process?

4.18 Training

1. How did employees receive qualification/training in each aspect of their job?
2. Is the training effectiveness verified?
3. Do you perform a training needs analysis?
4. If supervisors are qualified to sign off on training, where did they become qualified?
5. Can I see your training records?
6. How did you learn to set up this machine?

7. How did you learn to assemble this job?

4.19 Servicing

1. Show me your service reports, internal and field, for the last six months.
2. Tell me how service data is communicated to the other levels of the organization.

4.20 Statistical Techniques

1. What do you do when the dots on the chart are above or below the control limits?
2. What do you do when the line is trending up or down?
3. Does advanced quality planning develop the appropriate statistical techniques?
4. Are special techniques established and used per the guidelines of the AIAG manual?

Source ISO 9000/QS 900 Support Group. (1997). *QS 9000 auditors check list.* Caledonia, MI: ISO 9000/QS 9000 Support Group.

APPENDIX C. THE ATTRIBUTES OF SERVQUAL IN AUTOMOTIVE REPAIR

THE ATTRIBUTES OF SERVQUAL IN AUTOMOTIVE REPAIR

A. Fairness:

1. The facility I went to charged a fair price.
2. I felt I was taken advantage of by this facility.
3. The price I paid for labor was fair.
4. The price I paid for parts was fair.
5. I left knowing I was fairly treated.
6. The service personnel were honest.
7. The facility had my best interest in mind.

B. Empathy:

8. The service personnel listened to my problem.
9. The service personnel did not pay enough attention to me.
10. The facility understood what I wanted.
11. The service personnel explained the work to be performed.
12. The service personnel were respectful.
13. The service personnel were polite.
14. The service personnel were helpful.
15. The service personnel were friendly.

C. Responsiveness:

16. The service was completed in a timely manner.
17. The facility had my appointment scheduled promptly.
18. The facility scheduled my appointment near the date I desired.
19. Upon arrival, I was quickly waited on.
20. My car was ready when promised.

D. Reliability:

21. The facility did the work that was promised.
22. The service personnel were well trained.
23. I felt the service was done correctly on the first visit.
24. The service personnel were competent.

E. Convenience:

25. It was convenient to have my car serviced by this facility.
26. The facility is in an easily accessible location.
27. The facility had convenient hours.

Source: Andaleeb, S. S., & Basu, A. K. (1994). Technical complexity and consumer knowledge as moderators of service quality evaluation in automobile service industry. *Journal of Retailing, 70*(4), 367-381.

APPENDIX D. TOTAL QUALITY SYSTEM IMPLEMENTATION ASSESSMENT INSTRUMENT VALIDATION FORM

TOTAL QUALITY SYSTEM IMPLEMENTATION ASSESSMENT INSTRUMENT VALIDATION FORM

General Information: This instrument is designed to determine the level of quality system implementation in general automotive repair shops. You are being asked to determine the current level of quality system implementation in your automotive repair shop. The last section asks you to provide background information.

Comments on general information: _____

_____

Section I: Quality System Implementation

Directions: Please read each item and rate the frequency of occurrence on the five point scale.

(1: Never 2: Seldom 3: Sometimes 4: Often5: Always)

Comments on directions: _____

_____

	Appropriate	Not Appropriate	Modify
Criterion 1. Leadership			
1. Our quality policy or statement is communicated to all employees.	☐	☐	☐
2. I am involved in employee quality improvement activities.	☐	☐	☐
3. I communicate with customers about the level of satisfaction with our service.	☐	☐	☐
4. I am recognized by outside organizations for promoting quality.	☐	☐	☐
5. Public health and environment issues are addressed in our quality policy.	☐	☐	☐

Comments or additional items : _____

_____

Criterion 2: Customer Satisfaction			
6. A systematic process (questionnaire, interview, etc.) is used to gather customers' satisfaction perception and complaints.	☐	☐	☐

	Appropriate	Not Appropriate	Modify
7. A clearly stated price for each service item is established.	☐	☐	☐
8. Customers' repaired vehicles are delivered on time.	☐	☐	☐
9. A repair guarantee is offered.	☐	☐	☐
10. Complaints about employees are reviewed.	☐	☐	☐

Comments or additional items : _____

_____

Criterion 3: Empowerment

11. Employees participate in quality improvement efforts.	☐	☐	☐
12. Employees are engaged in quality improvement teams.	☐	☐	☐
13. Employees make repair decisions.	☐	☐	☐
14. Problem-solving techniques are used by employees to improve quality.	☐	☐	☐
15. Employees' ideas lead to quality improvement.	☐	☐	☐

Comments or additional items : _____

_____

Criterion 4: Continuous Improvement

16 Organization's quality goals and strategies are identified.	☐	☐	☐
17. Quality policy is revised according to the remarks of employees and customers.	☐	☐	☐
18. Resources (time, financial, etc.) for quality improvement activities are adequate.	☐	☐	☐
19. A quality improvement project is currently in process.	☐	☐	☐
20. Quality improvement decisions are derived from the results of the data analysis.	☐	☐	☐

Comments or additional items : _____

_____

	Appropriate	Not Appropriate	Modify
Criterion 5: Accountability			
21. The difference in pricing between my shop and others is investigated.	☐	☐	☐
22. The level of customer satisfaction is measured.	☐	☐	☐
23. The business losses from dissatisfied customers are identified.	☐	☐	☐
24. Data on re-work are collected.	☐	☐	☐
25. Data regarding the level of employee satisfaction are collected.	☐	☐	☐

Comments or additional items : _____

_____

Criterion 6: Communication			
26. Employees with the best performance are publicly rewarded.	☐	☐	☐
27. Communication among employees is encouraged.	☐	☐	☐
28. Effective techniques (toll free number, e-mail, internet, etc.) are used to gather customers' opinions.	☐	☐	☐
29. Customers' complimentary letters are posted or circulated.	☐	☐	☐
30. The contents of communication with customers are recorded.	☐	☐	☐

Comments or additional items : _____

_____

Criterion 7: Training			
31. Employees' training needs are identified.	☐	☐	☐
32. A structured quality training program is provided to employees.	☐	☐	☐
33. All employees attend quality training programs.	☐	☐	☐
34. Training records are documented.	☐	☐	☐
35. Rewards are offered to the employees who participate in training.	☐	☐	☐

Comments or additional items : _____

_____

Section II: Background Information
Directions: Please fill in the blank or circle the letter that best corresponds to your background and experience.

Comments on directions: _____

_____

	Appropriate	Not Appropriate	Modify
36. Gender: A. Female B. Male.	☐	☐	☐
37. Age: _____ (in years).	☐	☐	☐
38. How long have you been an automotive repair shop manager? _____ (in years).	☐	☐	☐
39. Education level (highest level achieved): A. High school B. Two-year college C. Four-year college D. Graduate school E. Other	☐	☐	☐
40. How much training have you had in quality management? _____ (in hours).	☐	☐	☐
40. Are you a member of any automotive or quality association (ex. SAE, ASQ)? A. If yes, which ones? _____. B. No.	☐	☐	☐
42. How many full-time employees are there in your automotive repair shop? _____.	☐	☐	☐

Comments or additional items : _____

_____

APPENDIX E. CUSTOMER SATISFACTION ASSESSMENT INSTRUMENT VALIDATION FORM

CUSTOMER SATISFACTION ASSESSMENT INSTRUMENT VALIDATION FORM

General Information: This survey is designed to explore the level of customer satisfaction in general automotive repair shops. You are being asked to determine the level of satisfaction regarding your current automotive repair experience. You are also being asked to provide background information. Please complete the questionnaire fold and return it to the auto repair shop manager.

Comments on general information:_____

_____

Section I: Customer Satisfaction

Directions: You are being asked to determine the degree of agreement or disagreement about each item based on the service you just received in this automotive repair shop.

(1: Strongly Disagree 2: Disagree 3: Neither Agree Nor Disagree 4: Agree 5: Strongly Agree)

Comments on directions: _____

_____

	Appropriate	Not Appropriate	Modify
Criterion 1: Fairness			
1. The price I paid for labor was fair.	☐	☐	☐
2. The price I paid for parts was fair.	☐	☐	☐
3. I left knowing I was fairly treated.	☐	☐	☐
4. The service personnel was honest.	☐	☐	☐
5. The business had my best interest in mind.	☐	☐	☐

Comments or additional items : _____

_____

Criterion 2: Empathy			
6. The service personnel listened to my problem.	☐	☐	☐
7. The service personnel explained the work to be performed.	☐	☐	☐
8. The service personnel were respectful.	☐	☐	☐

	Appropriate	Not Appropriate	Modify
9. The service personnel understood what I wanted.	☐	☐	☐
10. The service personnel were friendly.	☐	☐	☐

Comments or additional items : _____

_____

Criterion 3: Responsiveness

11. The business scheduled my appointment promptly.	☐	☐	☐
12. The business scheduled my appointment near or on the day I desired.	☐	☐	☐
13. Upon arrival, I was served quickly.	☐	☐	☐
14. I was informed when my car would be ready.	☐	☐	☐
15. The service was completed on time.	☐	☐	☐

Comments or additional items : _____

_____

Criterion 4: Reliability

16. The business completed the repair work based on the diagnosis.	☐	☐	☐
17. The problem was solved on the first visit.	☐	☐	☐
18. The service personnel were well trained.	☐	☐	☐
19. The business did the work that was promised.	☐	☐	☐
20. The service personnel were competent.	☐	☐	☐

Comments or additional items : _____

_____

Criterion 5: Convenience

21. It was convenient for me to contact the business.	☐	☐	☐
22. The business was in an easily accessible location.	☐	☐	☐
23. The business had convenient hours.	☐	☐	☐

	Appropriate	Not Appropriate	Modify
24. The business's guest room was comfortable.	☐	☐	☐
25. After dropping off the car, the business offered to transport me to home, work, etc.	☐	☐	☐

Comments or additional items : _____

_____

Section II: Background Information
Directions: Please fill in the blank or circle the letter that best corresponds to your background.

Comments on directions: _____

_____

	Appropriate	Not Appropriate	Modify
26. Gender: A. Female B. Male.	☐	☐	☐
27. Age: _____ (in years).	☐	☐	☐
28. Education level (highest level achieved): A. High school B. Two-year college C. Four-year college D. Graduate school E. Other.	☐	☐	☐
29. Annual family income: A. below 20,000 B. 20,001–30,000 C. 30,001–40,000 D. 40,001–50,000 E. 50,001–60,000 F. 60,001–70,000 G. 70,001–80,000 H. 80,001 above.	☐	☐	☐
30. The charge you paid for the service this time: _____ (in dollars).	☐	☐	☐
31. The age of the vehicle serviced: _____ (in years).	☐	☐	☐

Comments or additional items : _____

_____

APPENDIX F. A LETTER TO THE PANEL MEMBERS

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Department of Industrial
Education and Technology
114 I. Ed. II
Ames, IA 50011-3130
TEL: (515) 294-1033
FAX: (515) 294-1123

September 30, 1997

Dear Dr.

Thank you for agreeing to serve as an expert panel member for my study of auto repair organizations. The purpose of my study is to explore the relationship between TQM implementation and customer satisfaction in order to refine quality improvement strategies for the automotive repair industry.

Two instruments are being developed for the purpose of this study. The Total Quality System Implementation Assessment Instrument (TQSIAI) is based on the seven criteria of the Quality Management Scoping Study (QMSS). It will be completed by the managers of auto repair shops. The Customer Satisfaction Assessment Instrument (CSAI) is based on the five criteria of "SERVQUAL". It will be completed by the customers about their automotive repair experience.

As a person knowledgeable about survey research or management practices, I need your assistance in validating the two instruments. Enclosed is an information sheet which describes the application of the criteria in QMSS and SERVQUAL. Please examine the enclosed instrument validation forms and provide suggestions regarding:

1. the clarity of each item
2. the appropriateness of each item as it relates to the criteria
3. additional items that may have been omitted
4. the clarity of instrument instructions

Please return the completed validation forms in the envelope provided by October 3, 1997. If you have any questions or need any clarification, please contact me by e-mail or phone.

E-mail: jacobso@iastate.edu
Tel: (515) 292-9248

Thank you for your assistance.

Hsiu-Te Sung
Ph.D. Candidate

John C. Dugger, Ph.D.
Committee Chairperson

APPENDIX G. THE LIST OF THE PANEL MEMBERS

THE LIST OF THE PANEL MEMBERS

	Name	Position/Title	Department
1.	Dr. Chu, Chao-Hsien	Assoc Prof	Management
2.	Dr. Gelina, R. J.	Assoc Prof	Industrial Education and Technology
3.	Dr. Laczniak, R. N.	Assoc Prof	Marketing
4.	Dr. Shelley, M. C.	Prof	Statistic; Political Science

APPENDIX H. TOTAL QUALITY SYSTEM IMPLEMENTATION ASSESSMENT INSTRUMENT

TOTAL QUALITY SYSTEM IMPLEMENTATION ASSESSMENT INSTRUMENT

General Information: This instrument is designed to determine the level of quality system implementation in general automotive repair shops. You are being asked to share information about the current quality practices in your automotive repair shop. The last section asks you to provide background information.

Section I: Quality System Implementation

Directions: Please read each item and rate the frequency of occurrence on the five point scale.

		Never	Seldom	Sometimes	Often	Always
1.	Our quality policy is communicated to all employees.	1	2	3	4	5
2.	I am involved in employee quality improvement activities.	1	2	3	4	5
3.	I communicate with customers about their level of satisfaction with our service.	1	2	3	4	5
4.	I have been recognized by outside organizations for promoting quality.	1	2	3	4	5
5.	Public health and environment issues are addressed in our quality policy.	1	2	3	4	5
6.	A systematic process (questionnaire, interview, etc.) is used to assess customers' satisfaction and their complaints.	1	2	3	4	5
7.	A clearly stated price is established for each service item.	1	2	3	4	5
8.	Customers' repaired vehicles are delivered on time.	1	2	3	4	5
9.	A repair guarantee is offered to each customer.	1	2	3	4	5
10.	Complaints about employees are reviewed.	1	2	3	4	5
11.	Employees participate in quality improvement efforts.	1	2	3	4	5
12.	Employees are engaged in quality improvement teams.	1	2	3	4	5
13.	Employees make decisions about what repair need to be made.	1	2	3	4	5
14.	Problem-solving techniques are used by employees to improve quality.	1	2	3	4	5
15.	Employees' ideas lead to quality improvement.	1	2	3	4	5
16	Organization's quality goals and strategies are identified.	1	2	3	4	5
17.	Quality policy is revised according to the remarks of customers.	1	2	3	4	5
18.	Resources (time, financial, etc.) for quality improvement activities are adequate.	1	2	3	4	5
19.	A quality improvement project is in process.	1	2	3	4	5
20.	Quality improvement decisions are derived from the results of data analysis.	1	2	3	4	5
21.	The differences in pricing between my shop and others are investigated.	1	2	3	4	5
22.	The level of customer satisfaction is measured.	1	2	3	4	5
23.	The business losses from dissatisfied customers are identified.	1	2	3	4	5

	Never	Seldom	Sometimes	Often	Always
23. The business losses from dissatisfied customers are identified.	1	2	3	4	5
24. Data on re-work are collected.	1	2	3	4	5
25. Data regarding the level of employee satisfaction are collected.	1	2	3	4	5
26. Employees with the best performance are publicly rewarded.	1	2	3	4	5
27. Communication among employees is encouraged.	1	2	3	4	5
28. Effective techniques (toll free number, e-mail, internet, etc.) are used to gather customers' opinions.	1	2	3	4	5
29. Customers' complimentary letters are posted or circulated.	1	2	3	4	5
30. The contents of communication with customers are recorded.	1	2	3	4	5
31. Employees' training needs are identified.	1	2	3	4	5
32. A structured quality training program is provided to employees.	1	2	3	4	5
33. All employees attend quality training programs.	1	2	3	4	5
34. Training records are documented.	1	2	3	4	5
35. Rewards are offered to the employees who participate in training.	1	2	3	4	5

Section II: Background Information

Directions: Please fill in the blank or circle the letter that corresponds to your background and experience.

36. Gender: A. Female B. Male . 37. Age: _____ (years).

38. How long have you been an automotive repair shop manager? _____ (years).

39. Education level (highest level achieved): A. High school or below B. Two-year college C. Four-year college D. Graduate school E. Other.

40. How much training have you had in quality management? _____ (hours).

41. Are you a member of any automotive or quality association (ex. SAE, ASQ)?
A. If yes, which ones? _____. B. No.

42. How many full-time employees are there in your automotive repair shop? _____.

Five-dollar reward requested
Please print your name and address below

_____

_____

_____

APPENDIX I. CUSTOMER SATISFACTION ASSESSMENT INSTRUMENT

(FORM 1)

CUSTOMER SATISFACTION ASSESSMENT INSTRUMENT (FORM 1)

General Information: This survey is designed to explore the level of customer satisfaction in general automotive repair shops. You are being asked to determine the level of satisfaction regarding your current automotive repair experience. You are also being asked to provide background information. It will take you about 10 minutes to complete this questionnaire. Your responses will be kept confidential. Please complete the questionnaire, seal it in the envelope, and return it to the auto repair shop manager. If you have any questions, you may contact Dr. John C. Dugger in the Department of Industrial Education and Technology at Iowa State University [TEL: (515) 294-8528].

Section I: Customer Satisfaction

Directions: You are being asked to determine the degree of agreement or disagreement about each item based on the service you just received in this automotive repair shop.
(1: Strongly Disagree 2: Disagree 3: Neither Agree Nor Disagree 4: Agree 5: Strongly Agree)

1.	The price I paid for labor was fair.	1	2	3	4	5
2.	The price I paid for parts was fair.	1	2	3	4	5
3.	I left knowing I was fairly treated.	1	2	3	4	5
4.	The service personnel were honest.	1	2	3	4	5
5.	The business had my best interest in mind.	1	2	3	4	5
6.	The service personnel listened to my problem.	1	2	3	4	5
7.	The service personnel explained the work to be performed.	1	2	3	4	5
8.	The service personnel respected my needs.	1	2	3	4	5
9.	The service personnel understood what I wanted.	1	2	3	4	5
10.	The service personnel were friendly.	1	2	3	4	5
11.	The business answer my call promptly.	1	2	3	4	5
12.	My appointment was scheduled near or on the day I desired.	1	2	3	4	5
13.	When I arrived, I was serve quickly.	1	2	3	4	5
14.	The service was completed on time.	1	2	3	4	5
15.	I was informed when my car would be ready.	1	2	3	4	5
16.	All the problem were fixed that had been diagnosed.	1	2	3	4	5
17.	The problem was solved on the first visit.	1	2	3	4	5
18.	The service personnel were well trained.	1	2	3	4	5
19.	The business did the work that was promised.	1	2	3	4	5
20.	The service personnel were competent.	1	2	3	4	5

21. It was convenient for me to contact the business.	1	2	3	4	5
22. The business was in an easily accessible location.	1	2	3	4	5
23. The business has convenient hours.	1	2	3	4	5
24. The business's guest room was comfortable.	1	2	3	4	5
25. After dropping off the car, the business offered to transport me to where I need to go.	1	2	3	4	5

Section II: Background Information

Directions: Please fill in the blank or circle the letter that best corresponds to your background.

26. Gender: A. Female B. Male.

27. Age: _____ (years).

28. Education level (highest level achieved): A. High school or below B. Two-year college C. Four-year college D. Graduate school E. Other.

29. Annual family income (dollars): A. below 20,000 B. 20,001–30,000 C. 30,001–40,000 D. 40,001–50,000 D. 50,001–60,000 F. 60,001–70,000 E. 70,001–80,000 H. over 80,001.

30. How much did you pay for the service this time: _____ (dollars).

31. The age of the vehicle that was just serviced: _____ (years).

APPENDIX J. CUSTOMER SATISFACTION ASSESSMENT INSTRUMENT (FORM 2)

CUSTOMER SATISFACTION ASSESSMENT INSTRUMENT (FORM 2)

General Information: This survey is designed to explore the level of customer satisfaction in general automotive repair shops. You are being asked to determine the level of satisfaction regarding your current automotive repair experience. You are being asked to provide background information. It will take you about 10 minutes to complete this questionnaire. Your responses will be kept confidential. After completing the questionnaire, please follow the mailing instructions on the back and return it by November 27, 1997. If you have any questions, you may contact Dr. John C. Dugger in the Department of Industrial Education and Technology at Iowa State University [TEL: (515) 294-8528].

Section I: Customer Satisfaction

Directions: You are being asked to determine the degree of agreement or disagreement about each item based on the service you just received in this automotive repair shop.
(1: Strongly Disagree 2: Disagree 3: Neither Agree Nor Disagree 4: Agree 5: Strongly Agree)

1.	The price I paid for labor was fair.	1	2	3	4	5
2.	The price I paid for parts was fair.	1	2	3	4	5
3.	I left knowing I was fairly treated.	1	2	3	4	5
4.	The service personnel were honest.	1	2	3	4	5
5.	The business had my best interest in mind.	1	2	3	4	5
6.	The service personnel listened to my problem.	1	2	3	4	5
7.	The service personnel explained the work to be performed.	1	2	3	4	5
8.	The service personnel respected my needs.	1	2	3	4	5
9.	The service personnel understood what I wanted.	1	2	3	4	5
10.	The service personnel were friendly.	1	2	3	4	5
11.	The business answer my call promptly.	1	2	3	4	5
12.	My appointment was scheduled near or on the day I desired.	1	2	3	4	5
13.	When I arrived, I was serve quickly.	1	2	3	4	5
14.	The service was completed on time.	1	2	3	4	5
15.	I was informed when my car would be ready.	1	2	3	4	5
16.	All the problem were fixed that had been diagnosed.	1	2	3	4	5
17.	The problem was solved on the first visit.	1	2	3	4	5
18.	The service personnel were well trained.	1	2	3	4	5
19.	The business did the work that was promised.	1	2	3	4	5

20. The service personnel were competent.	1	2	3	4	5
21. It was convenient for me to contact the business.	1	2	3	4	5
22. The business was in an easily accessible location.	1	2	3	4	5
23. The business has convenient hours.	1	2	3	4	5
24. The business's guest room was comfortable.	1	2	3	4	5
25. After dropping off the car, the business offered to transport me to where I need to go.	1	2	3	4	5

Section II: Background Information

Directions: Please fill in the blank or circle the letter that best corresponds to your background.

26. Gender: A. Female B. Male.

27. Age: _____ (years).

28. Education level (highest level achieved): A. High school or below B. Two-year college C. Four-year college D. Graduate school E. Other.

29. Annual family income (dollars): A. below 20,000 B. 20,001–30,000 C. 30,001–40,000 D. 40,001–50,000 D. 50,001–60,000 F. 60,001–70,000 E. 70,001–80,000 H. over 80,001.

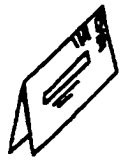
30. How much did you pay for the service this time: _____ (dollars).

31. The age of the vehicle that was just serviced: _____ (years).

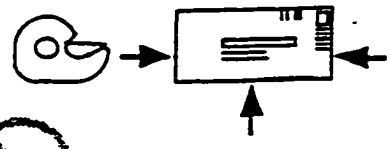
Mailing Instructions

Thank you very much for your contribution. Your efforts are appreciated. This questionnaire is marked for pre-paid postage for your convenience. Please follow these steps to insure that it is returned:

1. Fold the booklet in half. Make sure that the return address is facing out.



2. Seal the bottom and two ends shut with tape.



3. Please, do not staple.

4. Return the booklet by U.S. Mail.

No postage
necessary
if mailed
in the United States

P224-0123

Industrial Education and Technology
114 Ind. Ed. II

BUSINESS REPLY MAIL
FIRST-CLASS MAIL PERMIT NO. 675 AMES, IOWA

POSTAGE WILL BE PAID BY ADDRESSEE

IOWA STATE UNIVERSITY
ISU MAIL CENTER
AMES IA 50010-9901

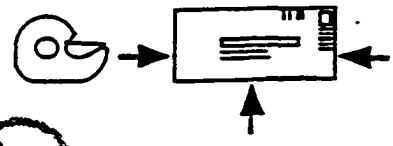
APPENDIX K. HUMAN SUBJECTS APPROVAL FORM

Mailing Instructions

Thank you very much for your contribution. Your efforts are appreciated. This questionnaire is marked for pre-paid postage for your convenience. Please follow these steps to insure that it is returned:

1. Fold the booklet in half. Make sure that the return address is facing out.

2. Seal the bottom and two ends shut with tape.



3. Please, do not staple.

4. Return the booklet by U.S. Mail.

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Industrial Education and Technology
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BUSINESS REPLY MAIL
FIRST-CLASS MAIL PERMIT NO. 675 AMES, IOWA

POSTAGE WILL BE PAID BY ADDRESSEE

IOWA STATE UNIVERSITY
ISU MAIL CENTER
AMES IA 50010-9901

APPENDIX L. COVER LETTER AND FOLLOW-UP LETTER FOR SERVICE MANAGERS

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

College of Education
Department of Industrial
Education and Technology
114 I. Ed. II
Ames, IA 50011-3130
TEL: (515) 294-1033
FAX: (515) 294-1123

September 30,1997

Dear Manager,

Developing a high quality service organization to increase customer satisfaction is one key to making greater profits in the automotive repair industry. It is our goal to explore the relationship between total quality management implementation and customer satisfaction in automotive repair service. The findings of this survey could produce strategies to increase the quality of service in your automotive repair shop.

There are three kinds of questionnaires enclosed in this envelop:

1. The yellow-colored questionnaire is designed to obtain your view on the current quality practices in your automotive repair shop.
2. Five copies of a green-colored questionnaire are designed to obtain your customers' views on customer satisfaction toward your repair shop. Please randomly choose five customers in five days (one customer a day) to respond to the questionnaires.
3. Five copies of a white-colored questionnaire are also designed to obtain your customers' views on customer satisfaction toward your repair shop. Please randomly choose five customers in five days (one customer a day) to respond to the questionnaires.

We will greatly appreciate it if you complete the yellow-colored questionnaire and collect the green-colored questionnaires. Please return them in the enclosed stamped, self-addressed envelope by October 30. Upon receipt your questionnaires, we will provide you with a reward of **five dollars and a copy of the strategies of how to improve service quality in your automotive repair shop.** The white-colored questionnaires will be returned by the customers themselves. Your responses will be kept completely confidential, your company name will never be placed on the final report, and all data will be reported by group. Code numbers are used only to identify respondents for grouping.

We would be most happy to answer any questions you might have. Please contact by e-mail or phone.

E-mail: jacobso@iastate.edu
Tel: (515) 292-9248

We want to thank you in advance for your assistance.

Jacob Sung
Ph.D. Candidate
Tel. (515) 292-9248
E-mail: jacobso@iastate.edu

John C. Dugger, Ph.D.
Committee Chairperson

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

College of Education
Department of Industrial
Education and Technology
114 I. Ed. II
Ames, IA 50011-3130
TEL: (515) 294-1033

November 30, 1997

Dear Auto Service Manager,

Around November 15 you were mailed a yellow-colored envelope in which there were three types of questionnaires. The yellow-colored questionnaire was designed to obtain your view on the current quality practices in your auto repair shop. Five copies of a green-colored questionnaire and five copies of a white-colored questionnaire were designed to obtain your customers' views on customer satisfaction regarding your repair shop.

Your participation is vital to the success of this study. Moreover, your response will contribute to future improvements in the auto repair industry. We also remind you that a reward of **$ 5** and **a copy of the auto repair service quality improvement strategies** will be provided upon receipt of your questionnaires.

Please complete the yellow-colored questionnaire, collect the green-colored ones, and mail them back with the stamped, self-addressed envelope enclosed in the previous letter by Dec. 12. We also need your help in distributing the white -colored questionnaires. After completing the white-colored questionnaires, the customers will return them by themselves. All responses will be kept completely confidential. If you have returned the questionnaires, please disregard this letter. If you have not received or misplaced the original mailing, please phone me and I will send you an additional copy.

E-mail: jacobso@iastate.edu
Tel: (515) 292-9248

Thank you for your assistance.

Jacob Sung
Researcher

John C. Dugger, Ph.D.
Committee Chairperson

APPENDIX M. RELIABILITY ANALYSIS OF THE TOTAL QUALITY SYSTEM IMPLEMENTATION ASSESSMENT INSTRUMENT

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
VAR00001	131.0000	293.1111	.2833	.9221
VAR00002	131.1071	288.5437	.4215	.9210
VAR00003	131.0714	290.6614	.3503	.9216
VAR00004	132.0357	280.4061	.5853	.9191
VAR00005	131.9643	278.0357	.5323	.9196
VAR00006	131.8571	269.1640	.6255	.9184
VAR00007	130.8214	289.6336	.3938	.9213
VAR00008	131.0357	290.4061	.3927	.9213
VAR00009	130.9643	287.8876	.4971	.9205
VAR00010	131.6429	281.1270	.4423	.9209
VAR00011	131.1071	289.8029	.4545	.9210
VAR00012	132.1071	278.5437	.5810	.9190
VAR00013	131.0000	297.4815	.0197	.9248
VAR00014	131.1786	293.7817	.1186	.9246
VAR00015	131.0714	288.5873	.5752	.9203
VAR00016	130.8929	290.2474	.4148	.9212
VAR00017	131.2143	286.3228	.4214	.9209
VAR00018	131.7500	283.8241	.5290	.9198
VAR00019	131.6786	280.1521	.5242	.9197
VAR00020	131.7143	275.6190	.5937	.9188
VAR00021	131.5000	287.0741	.4382	.9208
VAR00022	131.5000	288.7778	.2607	.9230
VAR00023	131.7143	286.6561	.2867	.9231
VAR00024	131.3571	280.2381	.5306	.9196
VAR00025	131.6071	278.7659	.5511	.9194
VAR00026	131.4286	279.8836	.6334	.9186
VAR00027	130.8214	288.0780	.4261	.9210
VAR00028	131.8929	263.5807	.7793	.9157
VAR00029	131.1071	277.0622	.5600	.9192
VAR00030	131.2857	271.5450	.6754	.9175
VAR00031	131.2143	282.0265	.5211	.9198
VAR00032	131.6429	272.6825	.7066	.9172
VAR00033	131.8214	271.9299	.7221	.9170
VAR00034	131.5357	276.1839	.4944	.9204
VAR00035	132.0714	266.4392	.6350	.9183

Reliability Coefficients

N of Cases = 28.0 N of Items = 35

Alpha = .9223

R E L I A B I L I T Y A N A L Y S I S - S C A L E A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
VAR00001	14.7742	6.0473	.4366	.6216
VAR00002	14.9355	5.3290	.4876	.5849
VAR00003	14.8065	6.2946	.2433	.6746
VAR00004	15.9355	4.5290	.4952	.5704
VAR00005	15.8065	3.6946	.5214	.5720

Reliability Coefficients

N of Cases = 31.0 N of Items = 5

Alpha = .6625

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
VAR00006	16.7419	4.4645	.4095	.5967
VAR00007	15.7742	7.2473	.2580	.6212
VAR00008	15.9677	7.4323	.3759	.5903
VAR00009	15.8387	7.0065	.4716	.5558
VAR00010	16.4516	4.9892	.5538	.4626

Reliability Coefficients

N of Cases = 31.0 N of Items = 5

Alpha = .6238

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
VAR00011	15.5667	3.8402	.3371	.3336
VAR00012	16.7000	2.6310	.2769	.3425
VAR00013	15.4667	3.7747	.1744	.4101
VAR00014	15.6667	3.2644	.1953	.4066
VAR00015	15.5333	4.1195	.2386	.3862

Reliability Coefficients

N of Cases = 30.0 N of Items = 5

Alpha = .4308

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
VAR00016	14.7097	6.3462	.3306	.5444
VAR00017	15.0000	6.9333	.0311	.6675
VAR00018	15.5806	5.3849	.4478	.4750
VAR00019	15.4516	4.3892	.5357	.3978
VAR00020	15.5161	4.2581	.4280	.4768

Reliability Coefficients

N of Cases = 31.0 N of Items = 5

Alpha = .5829

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
VAR00021	15.0000	6.5333	.2910	.4621
VAR00022	15.0000	6.2000	.1893	.5157
VAR00023	15.1290	5.5161	.2606	.4762
VAR00024	14.7742	5.5806	.3505	.4136
VAR00025	15.1935	5.2946	.3495	.4105

Reliability Coefficients

N of Cases = 31.0 N of Items = 5

Alpha = .5132

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
VAR00026	16.0357	10.7024	.6025	.7439
VAR00027	15.4286	13.2169	.2121	.8319
VAR00028	16.5000	7.6667	.7376	.6860
VAR00029	15.7143	9.5450	.5984	.7380
VAR00030	15.8929	8.6177	.7102	.6962

Reliability Coefficients

N of Cases = 28.0 N of Items = 5

Alpha = .7885

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
VAR00031	13.8710	15.3161	.4393	.8146
VAR00032	14.2903	12.3462	.7601	.7272
VAR00033	14.4839	12.6581	.7374	.7358
VAR00034	14.1935	11.7613	.6159	.7689
VAR00035	14.7742	11.9140	.5188	.8101

Reliability Coefficients

N of Cases = 31.0 N of Items = 5

Alpha = .8097

APPENDIX N. RELIABILITY ANALYSIS OF THE CUSTOMER SATISFACTION ASSESSMENT INSTRUMENT

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
VAR00001	96.6408	124.5658	.6337	.9135
VAR00002	96.5340	126.8983	.4766	.9166
VAR00003	96.2816	124.5768	.6611	.9130
VAR00004	95.9903	125.1077	.6666	.9130
VAR00005	96.1942	125.6874	.6050	.9141
VAR00006	96.0194	125.3722	.5586	.9149
VAR00007	96.0291	127.2835	.5531	.9150
VAR00008	96.1359	127.1578	.5919	.9144
VAR00009	96.1068	126.9002	.6419	.9138
VAR00010	95.7961	125.8110	.6739	.9131
VAR00011	96.0485	128.0270	.5605	.9150
VAR00012	95.9612	126.5083	.6295	.9138
VAR00013	95.9612	127.6259	.5189	.9156
VAR00014	96.0291	127.2638	.5648	.9148
VAR00015	96.2427	125.0876	.5910	.9143
VAR00016	96.1262	130.8172	.3474	.9184
VAR00017	96.2233	128.0771	.4533	.9168
VAR00018	96.1165	128.7118	.5059	.9158
VAR00019	96.0583	129.2711	.4848	.9162
VAR00020	95.9709	129.1070	.4441	.9169
VAR00021	96.0485	125.1839	.6649	.9131
VAR00022	96.0097	127.8332	.4498	.9170
VAR00023	95.8932	129.2336	.5030	.9159
VAR00024	96.3592	128.3109	.3629	.9193
VAR00025	96.7184	128.3023	.3727	.9190

Reliability Coefficients

N of Cases = 103.0 N of Items = 25

Alpha = .9185

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
VAR00001	15.6321	7.1491	.6781	.8129
VAR00002	15.5000	7.1476	.6176	.8309
VAR00003	15.2736	6.9625	.7692	.7888
VAR00004	14.9528	7.7406	.5929	.8348
VAR00005	15.1698	7.4376	.6452	.8218

Reliability Coefficients

N of Cases = 106.0 N of Items = 5

Alpha = .8492

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
VAR00006	16.5234	5.3461	.6618	.7946
VAR00007	16.5514	5.9667	.6052	.8080
VAR00008	16.6449	6.0802	.6356	.7998
VAR00009	16.6262	6.1420	.6504	.7967
VAR00010	16.3084	6.0832	.6301	.8012

Reliability Coefficients

N of Cases = 107.0 N of Items = 5

Alpha = .8335

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
VAR00011	16.4245	5.9419	.4055	.7656
VAR00012	16.3396	5.3121	.5838	.7087
VAR00013	16.3208	5.2866	.5401	.7230
VAR00014	16.3962	5.2320	.5966	.7038
VAR00015	16.6321	4.8824	.5660	.7152

Reliability Coefficients

N of Cases = 106.0 N of Items = 5

Alpha = .7667

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
VAR00016	16.2358	4.6581	.4478	.6739
VAR00017	16.3396	4.2645	.4937	.6562
VAR00018	16.2264	4.6530	.5000	.6539
VAR00019	16.1698	4.4471	.6043	.6145
VAR00020	16.0849	4.9927	.3305	.7198

Reliability Coefficients

N of Cases = 106.0 N of Items = 5

Alpha = .7128

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
VAR00021	15.6509	5.9437	.4300	.6238
VAR00022	15.6132	5.4013	.5050	.5879
VAR00023	15.5000	6.0048	.5196	.5977
VAR00024	15.9528	5.5120	.3648	.6580
VAR00025	16.3019	5.4699	.3776	.6515

Reliability Coefficients

N of Cases = 106.0 N of Items = 5

Alpha = .6742

APPENDIX O. FACTOR ANALYSIS OF THE CUSTOMER SATISFACTION ASSESSMENT INSTRUMENT

- - - - - - - - - - - F A C T O R A N A L Y S I S - - - - - - - - - - -

Analysis number 1 Replacement of missing values with the mean

Extraction 1 for analysis 1, Principal Components Analysis (PC)

Initial Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
VAR00001	1.00000	*	1	8.76171	35.0	35.0
VAR00002	1.00000	*	2	1.65873	6.6	41.7
VAR00003	1.00000	*	3	1.55336	6.2	47.9
VAR00004	1.00000	*	4	1.33511	5.3	53.2
VAR00005	1.00000	*	5	1.25752	5.0	58.3
VAR00006	1.00000	*	6	1.18312	4.7	63.0
VAR00007	1.00000	*	7	1.11046	4.4	67.4
VAR00008	1.00000	*	8	.94656	3.8	71.2
VAR00009	1.00000	*	9	.80243	3.2	74.4
VAR00010	1.00000	*	10	.71249	2.8	77.3
VAR00011	1.00000	*	11	.64175	2.6	79.9
VAR00012	1.00000	*	12	.63131	2.5	82.4
VAR00013	1.00000	*	13	.53086	2.1	84.5
VAR00014	1.00000	*	14	.51109	2.0	86.5
VAR00015	1.00000	*	15	.45267	1.8	88.4
VAR00016	1.00000	*	16	.41043	1.6	90.0
VAR00017	1.00000	*	17	.40018	1.6	91.6
VAR00018	1.00000	*	18	.38036	1.5	93.1
VAR00019	1.00000	*	19	.35129	1.4	94.5
VAR00020	1.00000	*	20	.30319	1.2	95.7
VAR00021	1.00000	*	21	.26556	1.1	96.8
VAR00022	1.00000	*	22	.24421	1.0	97.8
VAR00023	1.00000	*	23	.22332	.9	98.7
VAR00024	1.00000	*	24	.18554	.7	99.4
VAR00025	1.00000	*	25	.14677	.6	100.0

PC extracted 7 factors.

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Factor Matrix:

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
VAR00001	.66726	-.08021	-.34700	.07356	-.24161
VAR00002	.52745	.04482	-.59887	.15321	-.09502
VAR00003	.68459	.10622	-.52401	.00709	-.17877
VAR00004	.72215	-.10547	-.06686	-.08209	-.09970
VAR00005	.65785	-.00797	-.35732	-.06188	-.03118
VAR00006	.61385	-.18677	.36274	-.35559	-.23656
VAR00007	.60138	.23658	.23186	-.21947	-.24711
VAR00008	.63970	.03205	.22131	-.13459	-.19555
VAR00009	.68778	.02580	.18990	-.28188	-.26057
VAR00010	.72923	.03953	.20046	-.10949	-.02345
VAR00011	.59869	-.17586	.10210	.50530	.00907
VAR00012	.67082	-.13525	-.08108	-.18780	.15693
VAR00013	.56388	-.17304	-.18592	-.27193	.39970
VAR00014	.60775	-.10697	-.06767	-.15035	.54524
VAR00015	.63938	-.05147	-.03794	-.28219	.00681
VAR00016	.37147	.56769	-.01051	.07489	.01086
VAR00017	.47919	.50162	.01426	.15599	.04108
VAR00018	.54215	.41050	.08196	.23349	-.05135
VAR00019	.51637	.53250	.20812	.09321	.25575
VAR00020	.48979	.04385	.22142	.15673	.54845
VAR00021	.72154	-.12996	.24007	.06423	.02918
VAR00022	.50005	-.47923	.30357	.30608	-.08667
VAR00023	.53712	-.22563	.14559	.51252	-.10436
VAR00024	.39164	-.11788	-.07539	.25743	-.09261
VAR00025	.42153	-.31814	-.15294	-.01336	.20799

	Factor 6	Factor 7
VAR00001	-.19295	-.07910
VAR00002	.12795	-.17295
VAR00003	-.11411	-.06309
VAR00004	-.08853	-.29841
VAR00005	-.04536	-.15629
VAR00006	.21051	-.03251
VAR00007	.02528	.21786
VAR00008	.32635	-.27305
VAR00009	-.09733	.00794
VAR00010	-.08097	-.06586
VAR00011	-.25354	.11600
VAR00012	-.10936	.17854
VAR00013	.25306	-.04638
VAR00014	.01301	.00927
VAR00015	-.15094	.23917
VAR00016	.33994	-.01656
VAR00017	.00937	.33100
VAR00018	-.32247	.23208
VAR00019	.10780	-.11821
VAR00020	-.08846	-.33457
VAR00021	-.30537	-.05868
VAR00022	-.00860	.06326
VAR00023	.25734	-.17787
VAR00024	.59663	.25797
VAR00025	.14586	.57388

Final Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
		*				
VAR00001	.67934	*	1	8.76171	35.0	35.0
VAR00002	.71763	*	2	1.65873	6.6	41.7
VAR00003	.80355	*	3	1.55336	6.2	47.9
VAR00004	.65066	*	4	1.33511	5.3	53.2
VAR00005	.59179	*	5	1.25752	5.0	58.3
VAR00006	.77105	*	6	1.18312	4.7	63.0
VAR00007	.62872	*	7	1.11046	4.4	67.4
VAR00008	.69664	*				
VAR00009	.66665	*				
VAR00010	.59696	*				
VAR00011	.73293	*				
VAR00012	.57860	*				
VAR00013	.68236	*				
VAR00014	.70552	*				
VAR00015	.57256	*				
VAR00016	.58194	*				
VAR00017	.61712	*				
VAR00018	.68416	*				
VAR00019	.69319	*				
VAR00020	.73597	*				
VAR00021	.69681	*				
VAR00022	.67715	*				
VAR00023	.73203	*				
VAR00024	.67032	*				
VAR00025	.69635	*				

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VARIMAX rotation 1 for extraction 1 in analysis 1 - Kaiser Normalization.

VARIMAX converged in 13 iterations.

Rotated Factor Matrix:

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
VAR00001	.25404	.71016	.10629	.28781	.00031
VAR00002	-.01553	.78456	.11743	.03955	.10556
VAR00003	.18670	.82434	.23670	.08164	.04047
VAR00004	.47499	.52796	.03182	.25339	.28457
VAR00005	.25053	.66034	.10956	.09081	.22336
VAR00006	.82542	.04635	-.02167	.13069	.10985
VAR00007	.62208	.10961	.43412	.06683	-.05568
VAR00008	.65260	.21890	.12758	.10677	.23660
VAR00009	.71320	.25995	.20325	.16128	.04731
VAR00010	.55745	.24222	.25929	.26533	.27704
VAR00011	.06668	.24095	.23809	.75552	.10850
VAR00012	.35218	.32087	.12903	.16893	.26566
VAR00013	.24763	.29868	-.04645	-.08868	.55152
VAR00014	.17268	.21974	.10209	.08771	.64530
VAR00015	.45349	.29295	.18460	.09992	.11433
VAR00016	.14407	.15511	.60131	-.16041	.15834
VAR00017	.10208	.13691	.73139	.08203	.03314
VAR00018	.15055	.21462	.67992	.32740	-.00006
VAR00019	.21061	.06387	.64023	.04122	.45725
VAR00020	.08567	.05872	.19092	.31209	.76646
VAR00021	.44593	.23086	.17503	.53193	.28864
VAR00022	.29838	.02757	-.10582	.70622	.07875
VAR00023	.16496	.21051	.06184	.61449	.17246
VAR00024	.09925	.12793	.14199	.17336	-.04330
VAR00025	.05858	.09885	.04384	.71917	.04502

	Factor 6	Factor 7
VAR00001	.12650	-.01876
VAR00002	.05769	.26840
VAR00003	.15600	.02199
VAR00004	.00345	.00951
VAR00005	.14336	.04779
VAR00006	.13766	.19753
VAR00007	.17981	.03689
VAR00008	-.12282	.35228
VAR00009	.12870	-.06554
VAR00010	.11301	-.01954
VAR00011	.17611	.01247
VAR00012	.48188	-.06031
VAR00013	.41309	.21678
VAR00014	.43907	.01072
VAR00015	.45627	-.12561
VAR00016	-.10793	.33630
VAR00017	.19804	.07734
VAR00018	.10397	-.18744
VAR00019	-.10734	.11205
VAR00020	-.04435	-.04360
VAR00021	.13938	-.16833
VAR00022	.18268	.19452
VAR00023	-.09800	.48963
VAR00024	.27781	.71752
VAR00025	.17381	.21980

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Analysis number 1 Replacement of missing values with the mean

Extraction 1 for analysis 1, Principal Components Analysis (PC)

Initial Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
		*				
VAR00001	1.00000	*	1	3.11787	62.4	62.4
VAR00002	1.00000	*	2	.66246	13.2	75.6
VAR00003	1.00000	*	3	.51625	10.3	85.9
VAR00004	1.00000	*	4	.43302	8.7	94.6
VAR00005	1.00000	*	5	.27039	5.4	100.0

PC extracted 1 factors.

Factor Matrix:

	Factor 1
VAR00001	.80634
VAR00002	.75533
VAR00003	.86691
VAR00004	.73646
VAR00005	.77669

Final Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
		*				
VAR00001	.65019	*	1	3.11787	62.4	62.4
VAR00002	.57052	*				
VAR00003	.75153	*				
VAR00004	.54237	*				
VAR00005	.60325	*				

VARIMAX rotation 1 for extraction 1 in analysis 1 - Kaiser Normalization.

>Warning # 11310
>Only one factor was extracted. The solution cannot be rotated.

- - - - - - - - - - - F A C T O R A N A L Y S I S - - - - - - - - - - -

Analysis number 1 Replacement of missing values with the mean

Extraction 1 for analysis 1, Principal Components Analysis (PC)

Initial Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
VAR00006	1.00000	*	1	3.01921	60.4	60.4
VAR00007	1.00000	*	2	.63341	12.7	73.1
VAR00008	1.00000	*	3	.53255	10.7	83.7
VAR00009	1.00000	*	4	.42838	8.6	92.3
VAR00010	1.00000	*	5	.38646	7.7	100.0

PC extracted 1 factors.

Factor Matrix:

	Factor 1
VAR00006	.80031
VAR00007	.75309
VAR00008	.77524
VAR00009	.78545
VAR00010	.77049

Final Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
VAR00006	.64049	*	1	3.01921	60.4	60.4
VAR00007	.56714	*				
VAR00008	.60100	*				
VAR00009	.61693	*				
VAR00010	.59365	*				

VARIMAX rotation 1 for extraction 1 in analysis 1 - Kaiser Normalization.

>Warning # 11310
>Only one factor was extracted. The solution cannot be rotated.

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Analysis number 1 Replacement of missing values with the mean

Extraction 1 for analysis 1, Principal Components Analysis (PC)

Initial Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
		*				
VAR00011	1.00000	*	1	2.60660	52.1	52.1
VAR00012	1.00000	*	2	.82555	16.5	68.6
VAR00013	1.00000	*	3	.61149	12.2	80.9
VAR00014	1.00000	*	4	.54314	10.9	91.7
VAR00015	1.00000	*	5	.41323	8.3	100.0

PC extracted 1 factors.

Factor Matrix:

	Factor 1
VAR00011	.58195
VAR00012	.75957
VAR00013	.73544
VAR00014	.77287
VAR00015	.74349

Final Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
		*				
VAR00011	.33867	*	1	2.60660	52.1	52.1
VAR00012	.57695	*				
VAR00013	.54088	*				
VAR00014	.59732	*				
VAR00015	.55278	*				

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VARIMAX rotation 1 for extraction 1 in analysis 1 - Kaiser Normalization.

>Warning # 11310
>Only one factor was extracted. The solution cannot be rotated.

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Analysis number 1 Replacement of missing values with the mean

Extraction 1 for analysis 1, Principal Components Analysis (PC)

Initial Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
VAR00016	1.00000	*	1	2.37136	47.4	47.4
VAR00017	1.00000	*	2	.90804	18.2	65.6
VAR00018	1.00000	*	3	.69133	13.8	79.4
VAR00019	1.00000	*	4	.55608	11.1	90.5
VAR00020	1.00000	*	5	.47320	9.5	100.0

PC extracted 1 factors.

Factor Matrix:

	Factor 1
VAR00016	.66728
VAR00017	.71120
VAR00018	.71062
VAR00019	.79233
VAR00020	.53622

Final Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
VAR00016	.44526	*	1	2.37136	47.4	47.4
VAR00017	.50581	*				
VAR00018	.50498	*				
VAR00019	.62778	*				
VAR00020	.28753	*				

VARIMAX rotation 1 for extraction 1 in analysis 1 - Kaiser Normalization.

>Warning # 11310
>Only one factor was extracted. The solution cannot be rotated.

- - - - - - - - - - - F A C T O R A N A L Y S I S - - - - - - - - - - -

Analysis number 1 Replacement of missing values with the mean

Extraction 1 for analysis 1, Principal Components Analysis (PC)

Initial Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
		*				
VAR00021	1.00000	*	1	2.25500	45.1	45.1
VAR00022	1.00000	*	2	.97157	19.4	64.5
VAR00023	1.00000	*	3	.76955	15.4	79.9
VAR00024	1.00000	*	4	.53696	10.7	90.7
VAR00025	1.00000	*	5	.46692	9.3	100.0

PC extracted 1 factors.

Factor Matrix:

	Factor 1
VAR00021	.68233
VAR00022	.76822
VAR00023	.75440
VAR00024	.56205
VAR00025	.56059

Final Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
		*				
VAR00021	.46557	*	1	2.25500	45.1	45.1
VAR00022	.59016	*				
VAR00023	.56912	*				
VAR00024	.31590	*				
VAR00025	.31426	*				

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VARIMAX rotation 1 for extraction 1 in analysis 1 - Kaiser Normalization.

>Warning # 11310
>Only one factor was extracted. The solution cannot be rotated.

APPENDIX P. STEP-WISE LINEAR REGRESSION OF TQM IMPLEMENTATION AND THE THREE INFLUENTIAL VARIABLES

Notes

Output Created		30 Jan 98 16:30:05
Input	Data	A:\autoshop4.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	31
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS R ANOVA /CRITERIA=PIN(.05) POUT(.10) /NOORIGIN /DEPENDENT tqmimple /METHOD=STEPWISE empolyee manexper hourtung .
Resources	Memory Required	2020 bytes
	Additional Memory Required for Residual Plots	0 bytes
	Elapsed Time	0:00:03.41

Model Summary[a,b]

Model	Variables Entered	Variables Removed	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	Quality Training[c]	.	.476	.226	.196	.4595
2	Managerial Experience[d]	.	.637	.406	.358	.4106
3	Managerial Experience[d]	.	.637	.406	.358	.4106

a. Dependent Variable: TQM Implementation

b. Method: Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

c. Independent Variables: (Constant), Quality Training

d. Independent Variables: (Constant), Quality Training, Managerial Experience

e. Probability of F-to-enter = .050 limits reached.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.604	1	1.604	7.598	.011[b]
	Residual	5.490	26	.211		
	Total	7.094	27			
2	Regression	2.880	2	1.440	8.543	.001[c]
	Residual	4.214	25	.169		
	Total	7.094	27			
3	Regression	2.880	2	1.440	8.543	.001[c]
	Residual	4.214	25	.169		
	Total	7.094	27			

a. Dependent Variable: TQM Implementation

b. Independent Variables: (Constant), Quality Training

c. Independent Variables: (Constant), Quality Training, Managerial Experience

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.650	.114		32.068	.000
	Quality Training	5.414E-03	.002	.476	2.756	.011
2	(Constant)	3.922	.142		27.654	.000
	Quality Training	4.941E-03	.002	.434	2.802	.010
	Managerial Experience	-2.33E-02	.008	-.426	-2.751	.011
3	(Constant)	3.922	.142		27.654	.000
	Quality Training	4.941E-03	.002	.434	2.802	.010
	Managerial Experience	-2.33E-02	.008	-.426	-2.751	.011

a. Dependent Variable: TQM Implementation

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	Employee Number	.183[b]	.774	.446	.153	.541
	Managerial Experience	-.426[b]	-2.751	.011	-.482	.990
2	Employee Number	.090[c]	.415	.682	.084	.527
3	Employee Number	.090[c]	.415	.682	.084	.527[d]

a. Dependent Variable: TQM Implementation

b. Independent Variables in the Model: (Constant), Quality Training

c. Independent Variables in the Model: (Constant), Quality Training, Managerial Experience

d. This variable is not added to the model because PIN = .050 limits reached.

APPENDIX Q. STEP-WISE LINEAR REGRESSION OF CUSTOMER SATISFACTION AND THE THREE INFLUENTIAL VARIABLES

Notes

Output Created		07 Mar 98 16:20:49
Input	Data	A:\autodata3.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	107
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS R ANOV /CRITERIA=PIN(.05) POUT(.10) /NOORIGIN /DEPENDENT cslevel /METHOD=STEPWISE employee pa carage .
Resources	Memory Required	2284 bytes
	Additional Memory Required for Residual Plots	0 bytes
	Elapsed Time	0:00:04.07

Model Summary[a,b]

Model	Variables Entered	Variables Removed	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	Employee Number[c]	.	.356	.126	.118	.4365
2	Service Payment[d]	.	.459	.211	.195	.4169
3	Age of Vehicle[e]	.	.494	.244	.221	.4101
4	Age of Vehicle[e]	.	.494	.244	.221	.4101

a. Dependent Variable: Customer Satisfaction

b. Method: Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

c. Independent Variables: (Constant), Employee Number

d. Independent Variables: (Constant), Employee Number, Service Payment

e. Independent Variables: (Constant), Employee Number, Service Payment, Age of Vehicle

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.813	1	2.813	14.768	.000[b]
	Residual	19.431	102	.191		
	Total	22.244	103			
2	Regression	4.690	2	2.345	13.492	.000[c]
	Residual	17.554	101	.174		
	Total	22.244	103			
3	Regression	5.426	3	1.809	10.754	.000[d]
	Residual	16.818	100	.168		
	Total	22.244	103			
4	Regression	5.426	3	1.809	10.754	.000[d]
	Residual	16.818	100	.168		
	Total	22.244	103			

a. Dependent Variable: Customer Satisfaction

b. Independent Variables: (Constant), Employee Number

c. Independent Variables: (Constant), Employee Number, Service Payment

d. Independent Variables: (Constant), Employee Number, Service Payment, Age of Vehicle

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig
		B	Std. Error	Beta		
1	(Constant)	3.881	.060		64.043	.000
	Employee Number	1.7E-02	.004	.356	3.843	.000
2	(Constant)	3.931	.061		64.058	.000
	Employee Number	1.8E-02	.004	.395	4.425	.000
	Service Payment	-3.5E-04	.000	-.293	-3.286	.001
3	(Constant)	4.076	.092		44.272	.000
	Employee Number	1.7E-02	.004	.366	4.115	.000
	Service Payment	-2.9E-04	.000	-.247	-2.734	.007
	Age of Vehicle	-2.8E-02	.013	-.189	-2.092	.039
4	(Constant)	4.076	.092		44.272	.000
	Employee Number	1.7E-02	.004	.366	4.115	.000
	Service Payment	-2.9E-04	.000	-.247	-2.734	.007
	Age of Vehicle	-2.8E-02	.013	-.189	-2.092	.039

a. Dependent Variable: Customer Satisfaction

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	Service Payment	-.293[b]	-3.286	.001	-.311	.982
	Age of Vehicle	-.249[b]	-2.752	.007	-.264	.985
2	Age of Vehicle	-.189[c]	-2.092	.039	-.205	.927

a. Dependent Variable: Customer Satisfaction

b. Independent Variables in the Model: (Constant), Employee Number

c. Independent Variables in the Model: (Constant), Employee Number, Service Payment

APPENDIX R. LIST OF SUGGESTIONS ON ELIMINATING OF THE NONCONFORMANCE COST

LIST OF SUGGESTIONS ON ELIMINATING THE NONCONFORMANCE COST

1. Write scripts to ensure optimum time use on standard telephone transactions or inquiries.
2. Reduce busy signals and call overload by informing customers of best times to call.
3. Minimize callbacks by providing complete information on first call.
4. Reduce information inquiries by improving literature clarity.
5. Eliminate acknowledgments where practical.
6. Reduce order status inquiries by improving reliability of promises.
7. Reduce field service and other appointment status inquiries by improving the dispatch system.
8. Identify error sources and cut error rates systematically, starting with the most costly.
9. Level department workload by scheduling customer call-ins by location, type of business, or other identifier.
10. Use facsimile to relieve phone traffic and enable batching of low-priority materials.
11. Encourage use of mail with longer lead times, thereby imposing a discipline of systematic ordering on customers.
12. Use a recorder for overflow calls.
13. Use voice response units (VRUs) for handling routine calls.
14. Use time on "hold" to provide information to customers that will shorten the talk time when the call is answered.
15. Use voice-mail or recorders for after-hours calls.
16. Use voicemail to cut telephone tag and repetitive calls.
17. Call customers by appointment.
18. Cut red tape on adjustments.
19. Cut back on use of customer service department as message center for field sales personnel and others.
20. Set up a departmental quality circle with cost-reduction goals.
21. Develop computer-to-computer (EDI) transaction capability.
22. Develop priorities by customer class or channel.
23. Set productivity standards for most common, repetitive tasks.
24. Establish surcharges for special services.
25. Encourage use of self-service options by customers.

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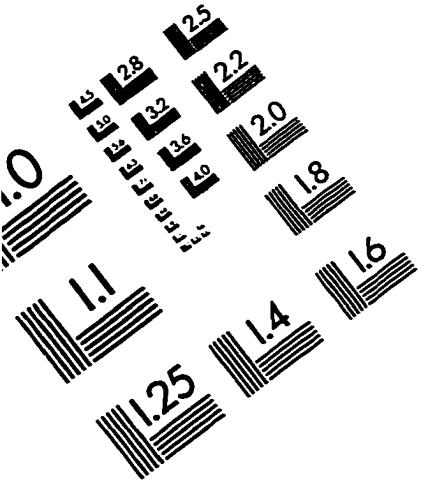
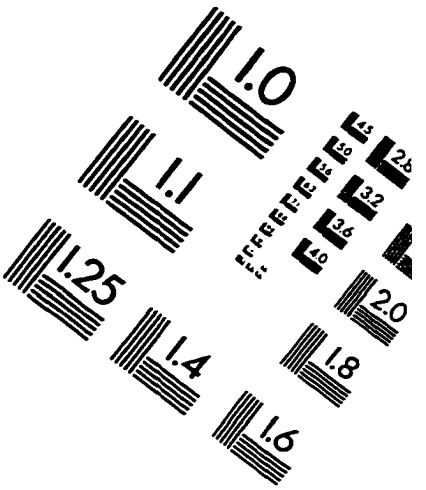
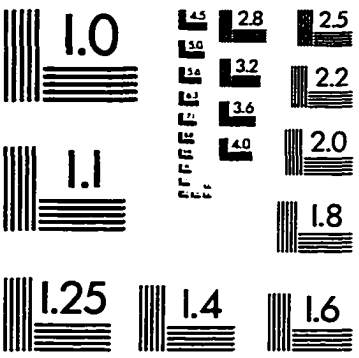
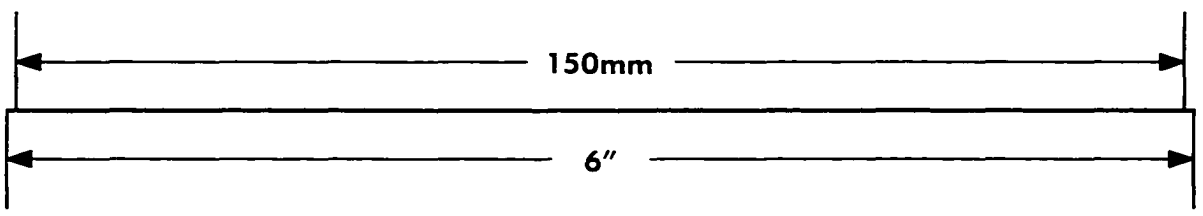
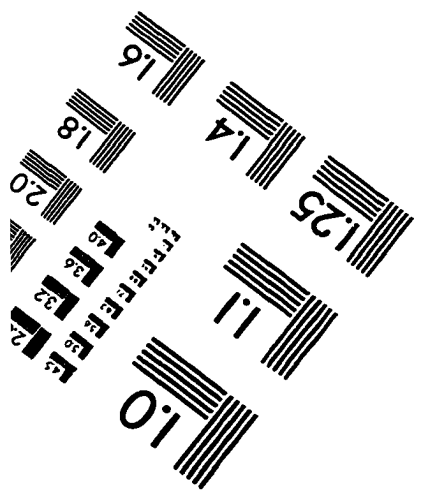
IMAGE EVALUATION TEST TARGET (QA-3)

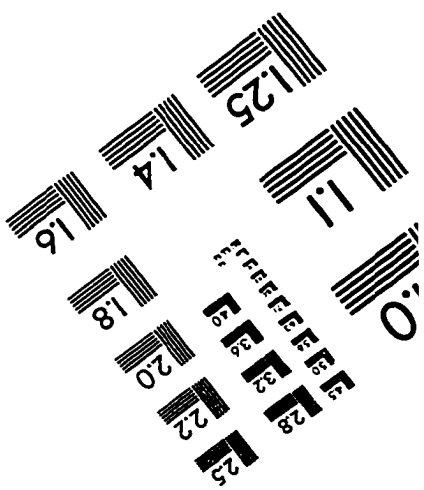












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